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SPECIAL NOTICE INSIDE

Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

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APRIL 23, 1970

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N70-19705—N70-21104

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1369**

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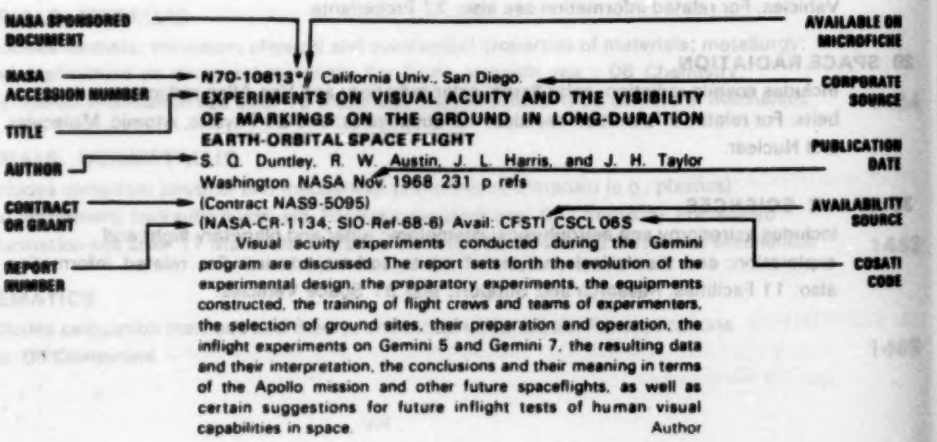
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
PUBLICATION DATE
Washington NASA Nov. 1968 231 p refs
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REPORT NUMBER
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author
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VOLUME 8 NUMBER 8 / APRIL 23, 1970

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-19720 Kansas Univ., Lawrence.
ON THE TWO-DIMENSIONAL ATMOSPHERIC TURBULENCE RESPONSE OF AN AIRPLANE
David Terry Sawdy (Ph.D. Thesis) 1968 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-5081

An analysis is formulated that predicts the motion and load responses of an airplane to a turbulence field that varies along the span as well as along the line of flight. A major feature is its aerodynamic versatility. The generalized aerodynamics forces can be calculated either by an unsteady lifting-surface theory or an unsteady modified-strip analysis that includes unsteady finite span induction effects. The analysis was applied to mathematical models of a rigid and a flexible airplane in the form of a trend study. Results indicate that the spanwise variation effect of the vertical gust velocity on the longitudinal motion and load responses can be significant for a large flexible airplane flying at altitudes of 1,000 feet or less. The trend study results show the rigid-body acceleration response predicted by a one-dimensional analysis to be a conservative estimate for large values of span to scale of turbulence ratio. Dissert. Abstr.

N70-19796*# Northrop Corp., Newbury Park, Calif. Ventura Div.
WIND TUNNEL AND FREE FLIGHT INVESTIGATION OF ALL-FLEXIBLE PARAWINGS AT SMALL SCALE
E. M. Linhart and W. C. Buhler Jun. 1969 215 p refs
(Contract NAS1-7467)
(NASA-CR-66879; NVR-6366A) Avail: CFSTI CSCL 01A

Maximum lift-to-drag ratios measured in wind tunnel tests were in the range of 2.5 to 2.7 for the single keel models and 3.2 to 3.4 for the twin keel models. Free flight gliding tests indicated maximum lift-to-drag ratios 10 to 15 percent less than those measured in the wind tunnels, due at least in part to the added drag of the test vehicles. Wing tunnel tests showed that maximum lift-to-drag ratio is strongly influenced by the length of the tip suspension lines for a given line length rigging, for both models. Deployment tests showed the need for a five stage deployment process in order to maintain deployment decelerations at or below 3 g's. Furthermore, tests demonstrated the practicality of multistage parawing reefing systems and, confirmed by scaled testing, the feasibility of deploying larger parawings with payloads of 5000 lb. at dynamic pressures up to 100 psf and altitudes up to 18,000 ft. Author

N70-20076 New York Univ., N.Y. School of Engineering and Science.
SONIC BOOM MINIMIZATION BY USE OF A MULTIWING CONCEPT
David Siegelman (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-4577

The sonic boom disturbance may be minimized by proper design of the lift generating surfaces. It is demonstrated that the multiwing configuration is an effective design for achieving low levels of overpressure. The work consists of calculating the pressure signature of a double delta wing, including interference between the components, and comparing the signature to that of an equivalent lift single wing. The calculations are performed by using linear theory to calculate the pressure disturbance on a reference plane. Effects due to trailing vortices and component interference are included. The reference plane pressure disturbance is then used to predict the ground track signature by application of the quasi-linear theory of Whitman. Dissert. Abstr.

N70-20275*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
NONLINEAR FLUTTER OF CURVED PLATES, PART 2
Earl H. Dowell [1969] 18 p refs
(Grant NGR-31-001-059)
(NASA-CR-108786) Avail: CFSTI CSCL 01A

Numerical results are presented for three-dimensional curved plates of constant curvature and simply supported on all edges. Quasi-steady supersonic aerodynamic theory is employed. These numerical results demonstrate some of the important qualitative and quantitative differences between three dimensional and two dimensional plates. Author

N70-20414*# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF HEAT TRANSFER IN A SIMULATED MARTIAN ATMOSPHERE Final Report, 1 Nov. 1968 – 15 Oct. 1969
S. H. Chue, N. Hanus, and E. R. F. Winter Oct. 1969 118 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952374)
(NASA-CR-108920) Avail: CFSTI CSCL 01A

A complete description is given of the problem of convective heat transfer under Martian atmospheric conditions, including reviews of the pertinent literature. Experiments were performed in a simulated Martian atmosphere with a low density wind tunnel. The experimental results demonstrate clearly that laminar continuum flow conditions existed over the entire range of this investigation. Hence convective heat transfer rates in a Martian atmosphere can be obtained from existing analytic solutions. The maximum error between the measured and calculated values for models tested was of the order of ten per cent. The major portion of this error is attributed to the uncertainties in the estimation of the heat losses. The difference in the Prandtl number of air and carbon

dioxide (0.71, 0.77 respectively) does not contribute significantly enough to the results to warrant the use of a specially prepared working fluid. Author

N70-20483# Technische Univ., Berlin (West Germany). Inst. fuer Luftfahrttriebwerke.
LAYOUT DIAGRAMS FOR AXIAL TURBINE STAGES [AUSLEGUNGSDIAGRAMME FUER AXIALTURBINENSTUFEN]
O. David, J. Hourmouziadis, and N. Marx Mar. 1969 63 p refs In GERMAN
(Repr-3) Avail: CFSTI

The presented layout diagrams are suitable for approximating axial turbine stages and for fast analyses of velocity triangles effects on work loads and on the characteristic parameters for turbine evaluation. Layout diagrams are presented in two versions that differ by their coefficient groups. The first coefficient group is based on the application of approximation theory and results give velocities made dimensionless by the peripheral speed of the runner; thus, the coefficients of this group are independent of fluid composition and their layout diagrams are applicable to all thermal turbines. The second coefficient group considers in addition also the laws of gas dynamics for an ideal gas. Their dimensionless velocities result from the sound velocity of the gas and are expressed in Mach numbers; thus, fluid dependent coefficient values are obtained when the specific heat ratio is known and constant. All layout diagrams are arranged in such a way that ordinates and abscissa are identical for both versions so that the parameters of their coefficient groups can be readily determined. Transl. by G.G.

N70-20508*# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
THEORETICAL INVESTIGATION OF CROSSFLOW EFFECTS ON COMPRESSIBLE TURBULENT BOUNDARY LAYER OVER BODIES OF REVOLUTION
Victor Zakkay and Wladimiro Calarese Dec. 1969 61 p refs
(Grant NGL-33-016-067)
(NASA-CR-108939; F-69-5) Avail: CFSTI CSCL 20D

An analysis for the compressible turbulent boundary layer undergoing both adverse pressure gradient and crossflow along a plane of symmetry is presented. The purpose is to provide a method for calculating boundary layers such as the ones that occur on the centerline of symmetry of an inlet. The three dimensional compressible integral equations are written along the symmetry plane, and integrated numerically, and in addition the effect of crossflow and the behavior of the boundary layer is studied. Included in the report are comparisons with the sparse amount of experimental results available in the literature. Author

N70-20513 National Lending Library for Science and Tehnology Boston Spa (England).
APPLICATION OF MASS COUPLING TO THE DETERMINATION OF STABILITY DERIVATIVES [ANWENDUNG DER MASSENKOPPLUNG ZUR BESTIMMUNG DER STABILITAETSDERIVATIVA]
Peter Hamel 2 Jan. 1970 33 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 15, no. 12, 1967 p 454-464
(NLL-Trans-1406-(5207)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

An investigation is made of the dynamic characteristics of an oscillatory model-balance system which can be used in conjunction with a wind tunnel to determine steady and unsteady derivatives of the longitudinal motion. The technique employs a translatory (heaving) and a rotary (pitching) degree of freedom. Displacement of the center of mass from the center of rotation, in combination with air loads, causes aeroelastic coupling. Either free or forced heaving-pitching oscillations can be used to obtain the derivatives. Finally, the root-locus method is used for a stability analysis. Author

N70-20609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND-TUNNEL INVESTIGATION OF SEVERAL LARGE-SCALE ALL-FLEXIBLE PARAWINGS
Michael D. Falarski (Army Aeronaut. Res. Lab.) and Kenneth W. Mort Washington Mar. 1970 40 p refs
(NASA-TN-D-5708; A-3190) Avail: CFSTI CSCL 01A

Parawings with 15- to 24-foot keel lengths were tested to determine their longitudinal force characteristics. The configurations tested were constructed by different techniques (glued, sewn, and sewn with reinforcing tapes), and one had multiple radial canopy slots. They were tested over a range of forward velocities. The differences in their aerodynamic characteristics were small (approximately 0.25 in lift-drag ratio). At low resultant forces the lift-drag ratio (L/D) of the configuration with multiple radial canopy slots was lower by 0.5 than that of the other single keel configurations. The results of the tests agreed well with small-scale results (5-ft keel length). Increasing the free-stream velocity from 29 to 58 feet per second reduced the L/D from a small decrement to approximately 0.5 for all the parawings tested except the 15-foot single keel which had no change in L/D with velocity. Author

N70-20996# British Aircraft Corp., London (England).
DEVELOPMENTS IN SUBSONIC LIFTING SURFACE THEORY
B. L. Hewitt May 1969 36 p refs Previously issued as TIL-BR-11767 BAC REP AE 282
(Contract KD/3D/24)
(S/T-MEMO-1/69) Avail: CFSTI

The development of numerical methods for solving the classical problem of subsonic lifting surface theory is critically reviewed. Brief details are given of a method of numerical solution, and its advantages over current methods are enumerated. Finally a numerical comparison is made between some results from the given method and a similar set from the method of Garner. Author

N70-21057# Naval Ordnance Lab., White Oak, Md.
VELOCITY PROFILE, SKIN FRICTION BALANCE AND HEAT TRANSFER MEASUREMENTS OF THE TURBULENT BOUNDARY LAYER AT MACH 5 AND ZERO PRESSURE GRADIENT Final Report
Roland E. Lee, William J. Yanta, and Annette C. Leonas 16 Jun. 1969 92 p refs
(AD-697929; NOLTR-69-106) Avail: CFSTI CSCL 20/4

The results of a detailed experimental investigation of a two-dimensional turbulent boundary layer at zero-pressure gradient are presented. The studies were made at the free-stream Mach number of 5, momentum-thickness Reynolds number from 4800 to 56,000 and wall-to-adiabatic-wall temperature ratios from 0.5 to 1.0. The data are in analytical terms of velocity profile, temperature profile, law-of-the-wall, velocity-defect law and incompressible form factor. Comparisons of local skin-friction coefficients obtained by four different experimental methods are shown. An empirical equation was derived from the shear-balance data to calculate the friction coefficient from known values of Mach number, heat transfer and Reynolds number. Author (TAB)

N70-21071# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PROBLEM OF THE UNSTEADY MOTION OF A WING AT VARIABLE DISTANCES FROM A GROUND-PLANE SURFACE
A. N. Panchenkov 18 Sep. 1969 24 p refs Transl. into ENGLISH from Gidrodinam. Bolshikh Skorostei (USSR), no. 2, 1966 p 7-24
(Contract NOw-62-0604-c)
(AD-697822; APL-CLB-3-T-602) Avail: CFSTI CSCL 1/3

An examination is made of the problem of determining the motion of a wing flying at variable distances from a ground-plane surface. Considered in succession are the two-and three-dimensional

problems for a wing near such a surface in an ideal incompressible fluid at a given horizontal velocity and for a certain vertical velocity in a spatially fixed coordinate system and, as well, for a coordinate system linked to the wing. It is concluded that the ground has a considerable effect on the unsteady characteristics of the wing during takeoff and landing, resulting in an appreciable variation of the lift and of the stability characteristics. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-19798# Boeing Co., Renton, Wash. Commercial Airplane Div.

SUBSONIC AIRCRAFT NOISE CONTROL PRACTISES AND EXPERIENCES

Chris L. Arctander 30 Dec. 1969 103 p
(D6-24564) Avail: CFSTI

This document discusses the practice of practical noise control by relating experiences in subsonic aircraft noise control to philosophies and actions which were needed to instill good noise control habits within varied engineering disciplines and decision making bodies. No attempt was made to derive the fundamental principles underlying the generation, transmission, reception, and dissipation of acoustic energy because available authoritative text books abound in such theory. Author

N70-19804*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

HANDLING QUALITIES OF THE XB-70 AIRPLANE IN THE LANDING APPROACH

Donald T. Berry and Bruce G. Powers Washington Feb. 1970 65 p refs
(NASA-TN-D-5676; H-587) Avail: CFSTI CSCL 01C

The XB-70 flight experience indicated that the height of the cockpit above the runway in combination with nose-high landing attitudes and high approach speeds made the landing task more difficult than that for current subsonic jet transports. Three-degree glide slopes were considered unsatisfactory at the 200-knot indicated airspeed approaches required by the XB-70. The high rate of descent reduced the time available to accomplish the flare and, therefore, increased the possibility of a hard landing. Large changes in lift due to elevon deflection were satisfactory because of the high control effectiveness. Laterally, the aircraft was sensitive to turbulence. Lateral-offset maneuvers simulating breakout from an overcast were not difficult; however, because of the higher approach speeds, excessive runway distances would be covered prior to touchdown and the adverse yaw accompanying aileron deflection was considered excessive. Sidestep maneuvering performance was adequately predicted by a simple technique. Author

N70-19971# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

FUTURE REQUIREMENTS FOR TACTICAL DATA HANDLING TECHNIQUES IN AIRCRAFT

Robert S. Aha *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 21-41 refs (See N70-19969 08-07)
Avail: CFSTI

This paper presents the need for developing data handling techniques to better satisfy the requirements of present and future tactical aircraft. Discussed are data handling requirements and problems of present and near future aircraft. Newer counterparts of these aircraft contain data handling requirements right up to the threshold of the state-of-the-art. A possible approach to the solution may be in the setting-up of an avionics panel made up of existing accredited associations along with military and industrial representatives to study, compile, and define the requirements of future tactical data handling techniques for aircraft. Author

N70-19994# Naval Air Development Center, Johnsville, Pa.

DATA HANDLING TECHNIQUES FOR LIGHT ATTACK AIRCRAFT

R. Y. Beesburg *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 339-348 (See N70-19968 08-07)
Avail: CFSTI

Discussed are data handling techniques and their application to integrated avionics systems by using a functionally modular, building block design. The following systems characteristics are considered for the integration of avionic equipment carried in modern light attack aircraft: (1) functional modularity of the major functions; (2) standard digital interface; (3) asynchronous control of data transmission; (4) bit-serial, word-serial data flow; (5) dual channel transmission; (6) flexible memory configuration; and (7) multiple channel transmission. G.G.

N70-20362# Matrix Corp., Alexandria, Va.

EFFECTS OF VIBRATION ON NAVY AND MARINE CORPS HELICOPTER FLIGHT CREWS Final Report, 1 Feb.-31 Jul. 1969

James M. Ketchel, James W. Danaher, and Charles J. Morrissey 1 Aug. 1969 183 p refs
(Contract N00014-69-C-0289)
(AD-698194) Avail: CFSTI CSCL 5/5

Identifiable vibration characteristics of contemporary military helicopters are described. These provide a basis for analyzing and interpreting the literature on vibration research. Emphasis is given to experimental results which relate to frequencies and acceleration amplitudes falling within the helicopter main rotor effects region. The spectrum of military helicopters is tabulated briefly and six representative Navy/Marine Corps helicopters, missions and associated flightcrew tasks are described in more detail. Perceptual-motor behaviors comprising crew tasks in the six missions are identified. These are used to relate vibration analysis results to the helicopter situation. Author (TAB)

N70-20392*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

THE X-15, A ROCKET-ASSISTED AIRCRAFT: A DEMAND BIBLIOGRAPHY

20 Nov. 1969 21 p refs
(NASA-TM-X-64070; GP-790) Avail: CFSTI CSCL 01C

A bibliography of books, documents, and magazine articles on the X-15 experimental research program is presented. Included are references to performance, systems, flight tests, and aerodynamic characteristics. F.O.S.

N70-20432*# LTV Aerospace Corp., Hampton, Va. Missiles and Space Div.

INERTIA TESTS OF A 24 FOOT SINGLE KEEL PARAWING, MODEL 2

Dan O. Summers 20 Jan. 1969 53 p refs
(Contract NAS1-6957)
(NASA-CR-66767; Rept-2) Avail: CFSTI CSCL 01C

The tests were conducted in a 60 ft. vacuum sphere. The pressure and temperature inside the sphere was sea level. The wing tested was mounted on a pendulum supported frame and they were oscillated to measure periods. The data recorded consisted of stop watch times, damped oscillations on oscillograph paper, pressure and temperature in the sphere, and moisture content. The damped oscillations were measured by accelerometers mounted on the pendulum. The wing was tested in pitch and roll. The inertias and masses of the tares and frames used, as well as the inertias

for the wings alone are presented. The inertia calculations at the harness end are taken where the harness attaches to the payload. This tie down point was selected for the inertias instead of the confluent point because it is intended that the inertia of the entire wing assembly be made readily available for use in data analysis. The inertia calculations are based on the parawing keel angle of 9 deg 17 min with the horizontal. Author

N70-20436*# California Univ., Davis. Coll. of Engineering.
CONTROL POWER REQUIREMENTS OF VTOL AIRCRAFT
Quarterly Status Report, 1 Oct. – 31 Dec. 1969
Myron A. Hoffman 31 Dec. 1969 19 p
(Grant NGR-05-004-051)
(NASA-CR-108914; QSR-3) Avail: CFSTI CSCL 01C

The VTOL performance and DOC (direct operating cost) computer program has been modified for the design of pure jet lift short-haul transports. This design, based on the proposals of several aerospace companies, has been adopted as our reference vehicle for the VTOL control power studies. In this design concept, the jet lift engines are removed from the fuselage and put in pods attached to the outer portions of the wings. This vehicle has cruising speed of 520 mph and a maximum range of 600 miles. It is designed for 100 passengers in the VTOL mode and 150 passengers in the STOL mode (400 ft. takeoff field length). Three computer runs for this design at three different levels of control power, 15%, 20% and 25% of the required thrust horsepower, are included. The program printouts include vehicle dimensions, performance, DOC and moments of inertia. This reference design will be used in the lateral hover control-power studies now in progress as soon as satisfactory stability derivatives are in hand. Author

N70-20455# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERONAUTICAL KNOWLEDGE: SELECTED ARTICLES
Tsung Hsing et al 3 Mar. 1969 18 p refs Transl. into ENGLISH from Hang K'ung Chin Shih (Chinese), v. 2, no. 6, 1965 p 31-33
(AD-695880; FTD-HT-23-648-68) Avail: CFSTI CSCL 1/3

On 09 April 1965, eight F4H carrier based interceptors intruded into Chinese air space over Hainan Island. They were armed with Sparrow air to air guided missiles. One of the planes accidentally shot itself down with its own missile. The wreckage of the plane and missile were recovered in Tung-fang Hsien Hainan Island. Author (TAB)

N70-20461# Army Foreign Science and Technology Center, Washington, D.C.
VERTICAL LANDING AND TAKEOFF AIRCRAFT
Viktor Fedorovich Pavlenko 21 Oct. 1969 276 p refs Transl. into ENGLISH from the Russian
(AD-698159; FSTC-HT-23-967-68) Avail: CFSTI CSCL 1/3

The book is devoted to new types of flying craft -- vertical takeoff and landing aircraft (VTOL). These aircraft make it possible to obviate the need for awkward and vulnerable airfields and can carry out rapid and sweeping flight maneuvers. They also mean that hauling of passengers and cargo in local airlines can be done with greater efficiency and more economically. Author (TAB)

N70-20493*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDY OF COUPLED ROLL-SPIRAL MODE EFFECTS ON LATERAL-DIRECTIONAL HANDLING QUALITIES
William D. Grantham, Frederick L. Moore, Perry L. Deal, and James M. Patton, Jr. Washington Mar. 1970 46 p refs
(NASA-TN-D-5466; L-6702) Avail: CFSTI CSCL 01C

A piloted fixed-base simulator study was made to provide a preliminary determination of the effects of a coupled roll-spiral mode on lateral-directional handling qualities. The coupling of the roll and spiral modes is characterized as an unconventional lateral oscillatory mode and has only recently become of interest since conventional aircraft have not displayed this phenomenon. No attempt is made to establish any kind of handling-qualities criteria because of the limited scope of the investigation, including the limitations of fixed-base simulation. The results indicate that when the conventional roll and spiral modes couple, the lateral-directional handling qualities are seriously degraded regardless of how the coupling was brought about, that is, regardless of which aerodynamic derivative or combination of derivatives caused the two modes to couple. When this coupling occurs, regardless of the cause of the coupling, the pilot sees a serious degradation in roll damping. The comments made by the pilots and the pilot ratings assigned to the various configurations evaluated seemed to correlate somewhat in terms of the frequency of the roll-spiral mode in that acceptable pilot ratings were more probably if the frequency of the coupled roll-spiral oscillatory mode was greater than 0.35 rad/sec, and indications were that this frequency should not be greater than approximately 1.0 rad/sec. There did not seem to be any definite trend regarding the magnitudes of the damping ratio of the coupled roll-spiral oscillatory mode or damping ratio of the Dutch roll mode required for satisfactory pilot ratings. Author

N70-20666# Boeing Co., Renton, Wash. Commercial Airplane Div.
TECHNIQUES USED TO DETERMINE ARTIFICIAL ICE SHAPES AND ICE SHEDDING CHARACTERISTICS OF UNPROTECTED AIRFOIL SURFACES
Ramon W. Wilder [1969] 68 p refs Presented at the Federal Admin. Symp. on Aircraft Ice Protect., Washington, D.C., 28–30 Apr. 1969 Sponsored by FAA
Avail: Issuing Activity

Ice accretion tests were conducted on two swept airfoil sections representative of the inboard and outboard wing or horizontal stabilizer airfoil sections of typical jet transports. The size and shape of these ice accretions were measured through photographs and actual plaster casts of the ice cap. Tests were conducted over a range of simulated flights and icing conditions designed to give the rough or glaze shape, which results in the highest drag penalty. These test results were then correlated with theoretical water impingement parameters obtained from a digital computer program. Ice accretion characteristics are discussed and shown to be dependent on airfoil shape, particularly leading edge radius, camber, and angle of attack. The test data and results are comparable to limited published ice accretion data on an unswept 65A004 airfoil. An empirical relationship is developed which correlated measured ice accretion rates with theoretical water impingement parameters. The correlation was obtained primarily by use of glaze ice heights and angles measured from the plaster casts of the actual ice shapes as taken from the two swept airfoil models. Author

N70-20725*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A REACTION ATTITUDE CONTROL SYSTEM FOR JET VTOL RESEARCH AIRCRAFT
Frank A. Pauli, Tom G. Sharpe, and James R. Rogers Washington Mar. 1970 12 p ref
(NASA-TN-D-5715; A-2862) Avail: CFSTI CSCL 01C

A new dual reaction control system provides the means for flight research on the requirements for VTOL attitude control systems. There are two conflicting requirements for any control system used in flight research. One is flexibility and the other is safety. Maximum flexibility can best be achieved by an electrically driven control system, but this frequently degrades safety. Maximum safety is provided by a mechanical control system, but this type system is difficult to change or adjust. Pilots consider their safety is not endangered if it is possible to switch from an electrical drive system to a mechanical drive system in about 0.1 sec after an electrical failure. The new dual reaction control system satisfies this requirement with a fail safe air switching system that controls 8.5 lb m/sec of 500 F air. The research control system is an electrical drive system. The air switching concept set the requirement for

large reaction control nozzles to handle the required air flow without excessive losses. Large nozzles, however, require large driving torques, although some nozzle types have lower driving torque requirements than others. An experimental determination was made for several reaction nozzle concepts to find the type with the lowest torque requirement. An outside can-type was devised that had sufficiently low driving torques (290 in. oz for 60 psig air using a 3 sq in. exit area) so that a low power and low weight servomotor could be used and still achieve high response. It was also found that additional lift could be developed by a variation in this type nozzle. Author

N70-20826# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MOTION OF AIRCRAFT WITH LIFTING AIRFOILS ABOVE A ROUGH WATER SURFACE
V. I. Korolev 23 Sep. 1969 12 p Transl. into ENGLISH from Gidrodinamika Bolshikh Skorostei (USSR), no. 2, 1966 p 75-80
(Contract NOw-62-0604-g)
(AD-697823; APL-CLB-T-605) Avail: CFSTI CSCL 1/3

The problem of the steady motion of a high-speed vehicle with lifting airfoils flying above a rough water surface is discussed under the assumption of regular, cylindrical low-amplitude waves, the direction of the wave-crest coinciding with the spanwise plane of the vehicle. The critical conditions for safe operation of such aircraft are defined. Author (TAB)

N70-20843*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.
DEVELOPMENT OF MECHANISMS FOR A PLANETARY LANDING PARACHUTE SYSTEM
Thomas H. Mack 15 Feb. 1970 15 p refs
(Contract NAS7-100)
(NASA-CR-109126; JPL-TM-33-441) Avail: CFSTI CSCL 01C

An effort was undertaken to develop mechanisms for a planetary landing parachute system that would: (1) keep the parachute from enveloping the lander, and (2) jettison the parachute deployment mortar such that it would not interfere with either the landing system or the postlanding antenna patterns. The development and testing of such mechanisms are described. Author

N70-20887# Thompson Aircraft Tire Corp., San Francisco, Calif.
MAXIMUM MODULUS RUBBER AIRCRAFT TIRES Technical Report, Oct. 1965-May 1969
William H. Protzmann Nov. 1969 112 p refs
(Contract AF 33(657)-15191)
(AD-697393; ASD-TR-69-111) Avail: CFSTI CSCL 1/3

The purpose of the program was to select and develop maximum modulus elastomeric materials for aircraft tires to increase the resistance to thermal and oxidative degradation to oils and chemicals, and to wear and cutting. Such improvements in these parameters would offer improved resistance to aging and deterioration of USAF aircraft tires. From eight candidate elastomers, two synthetic and one non-synthetic elastomers were selected. During construction of tires for qualification tests, processing techniques were developed for the new polyurethane materials. Author (TAB)

N70-21017# Air Force Cambridge Research Labs., Bedford, Mass.
PROCEEDINGS OF THE FIFTH AFCRL SCIENTIFIC BALLOON SYMPOSIUM
Lewis A. Grass, ed. Dec. 1968 334 p refs Held at Portsmouth, N.H., 17-19 Jun. 1968
(AD-685726; AFCRL-68-0661) Avail: CFSTI CSCL 1/3

The document covers a series of papers given at the fifth AFCRL scientific balloon symposium. The subjects were selected to cover the most recent developments in balloon technology and examples of the use of balloons for research purposes. The symposium is intended to provide an exchange of information for the developers of balloon systems and provides an excellent opportunity for scientists to discuss potential balloon capabilities and applications for the accomplishment of scientific programs. Balloon technology presentations included recent material investigations, tandem balloon stress analysis, balloon instrumentation, tethered balloons, cryoinflation feasibility studies and proposed launching techniques for large balloon systems. Author (TAB)

N70-21063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT EQUIPMENT
E. G. Palenyi 15 Aug. 1969 209 p refs Transl. into ENGLISH from Russian
(AD-697711; FTD-HT-23-1215-68) Avail: CFSTI CSCL 1/3

Classification is made of extensive and complex data on equipment, including discussions of most recent achievements in the field not covered elsewhere. Theoretical fundamentals, operating principles and design of modern instrumentation are dealt with in detail, involving such topics as electrical, radio, pressurization and similar equipment. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-19924*# CARA Corp., Philadelphia, Pa.
THE RELATION BETWEEN SOLAR CELL FLIGHT PERFORMANCE DATA AND MATERIALS AND MANUFACTURING DATA Quarterly Report
S. R. Pollack [1969] 38 p refs
(Contract NASw-1732)
(NASA-CR-108095; QR-3; Rept-3) Avail: CFSTI CSCL 10B

The most difficult aspect of the environmental analysis is the specification of the vehicle's thermal history. The vehicles under study are therefore grouped according to subclassifications based on the nature of the vehicle as the first attempt to find any performance correlations. All of the specific data for the flights under study were extracted from the literature obtained from the computer searches conducted earlier. These data are incomplete and inadequate for this study. Examples of the nature of this data were reported in the last quarterly report and are shown in this report. The data required for this study was obtained by personal contacts with individuals who were connected with the various flights. The appropriate individuals to contact were identified for 75 of the 77 flights included in this study. These people were and are being contacted to obtain the required data. Author

N70-20045# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DESIGN AND ANALYSIS OF SOLAR CELL ARRAY CONFIGURATIONS FOR VERTICALLY STABILIZED SATELLITES IN NEAR-EARTH ORBITS
Walter E. Allen Aug. 1969 159 p refs
(Contract NOw-62-0604-c)
(AD-697902; APL-TG-1066) Avail: CFSTI CSCL 10/2

Solar array configuration design and analysis techniques are developed from basic solar cell performance characteristics. The relationship between the array and other elements in the power system is presented with emphasis on nickel-cadmium battery characteristics as they relate to the design of the array. The predictable solar orientation patterns for two and three axis vertically stabilized spacecraft are examined in detail. The influence of the orbit upon the design of the array and methods for predicting sunlight exposure time and integrated average array power are introduced. The effects of the orbit environment upon array

performance including variations in solar illumination intensity, degradation caused by particle irradiation, and the potential influence of earth albedo are discussed. Finally, a specific array design is undertaken for a vertically stabilized spacecraft with a constant 20-watt electrical load. The design, although specific, demonstrates solar-array design principles and techniques that are universally applicable. Author (TAB)

N70-20128 Iowa State Univ. of Science and Technology, Ames.
DIGITAL STABILITY ANALYSIS OF POWER GENERATING UNITS
Joseph Donald Musil (Ph.D. Thesis) 1968 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-4268

Digital stability studies on power generating units are broken down into two main sub-divisions, steady-state and transient stability. When conducted on a time-dependent basis, steady-state stability becomes dynamic stability. Here the units are under automatic control, the voltage regulator, governor, and other auxilliary devices. Their stability is checked with only a small perturbation from their steady-state operating point. The ability of the units to return to the desired operating level determined their stability. The length of a multi-step analysis with its intermediate load-flow adjustments projected from the initial conditions, and dependent upon the accuracy of the system modeling and numerical analysis, rendered a steady-state stability check of several seconds inconclusive as well as costly. The approach used seeks to find a simpler answer to dynamic stability through the use of eigenvalues without extensive programming and digital computer time. Dissert. Abstr.

N70-20148*# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
DEVELOPMENT OF AN INTEGRATED LIGHTWEIGHT FLEXIBLE SILICON SOLAR CELL ARRAY Quarterly Technical Report, 1 Oct. 1969 – 1 Jan. 1970
E. L. Ralph, E. F. Zimmerman, and P. M. Stella 1 Jan. 1970 45 p Prepared for JPL
(Contracts NAS7-100; JPL-952580)
(NASA-CR-108782; RO-70-9; QTR-2) Avail: CFSTI CSCL 10B

Coverglass cost data was presented to show how significant cost savings can be realized through the development of new coverglass systems. Interconnector tests performed included drum rolling of assembled modules, 90 deg bend testing of interconnector strips, and stress/strain examination of deposited laminates. The 90 deg bend tests agreed with theoretical consideration, producing greater fatigue resistance for thin interconnectors. Third, the stress/strain data and the mechanical integrity of the interconnector-polyimide laminate demonstrated the potential for using this type material as an electrical circuit member or a conductive substrate. A preliminary thermal stress analysis performed on the interconnector-solder-silicon system has shown the effect of interconnector thickness and material on the individual stresses. Author

N70-20285# Eagle-Picher Co., Joplin, Mo.
VENTED NICKEL-CADMIUM BATTERY ASSEMBLY BB-500( )/U Final Report, 15 Dec. 1967-30 May 1969
William C. Harsch Nov. 1969 137 p
(Contract DAAB07-68-C-0160)
(AD-698030; ECOM-0160-F) Avail: CFSTI CSCL 10/3

The report contains the results of this contract which was to design, develop and test the BB-500( )/U battery assembly. The BB-500( )/U battery assembly is a rechargeable, vented, sintered-plate, nickel-cadmium storage battery. The battery assembly has a military-ruggedized design and consists of twenty (20) individual, series-connected cells in a double-decked configuration. The individual cells are the BB-437( )/U batteries and are contained in stainless steel trays, housed in a fiberglass exterior case. The battery assembly is equipped with military equipment connectors to prevent reverse polarity and voltage mis-match connections. As a result of the USAECOM connector arrangement, the BB-500 ( )/U battery assembly is rated at 24 volts and 9 ampere-hours or 12 volts and 18 ampere-hours. Author (TAB)

N70-20335*# Boeing Co., Seattle, Wash. Aerospace Group.
MARS MISSION SOLAR ARRAY Semiannual Progress Report, Period Ending 31 Dec. 1969
J. W. Ketchum, J. A. Lackey, S. M. Mitsui, D. A. Norsen, and H. M. Mc Daniel Feb. 1970 108 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952571)
(NASA-CR-108785; D2-121319-1) Avail: CFSTI CSCL 10B

This report provides technical information concerning the preliminary design, analysis, test article design, fabrication, and test of a beryllium-structure solar panel. The test panel being fabricated under this contract is a prototype of a solar panel design suitable for a Mars mission in 1973. This report describes the activity through December 31, 1969, which includes the completion of preliminary and detail design of the test panel, summary of the thermal, dynamic, and static analyses, and the fabrication and test efforts in progress. Author

N70-20336*# Texas Instruments, Inc., Dallas.
DEVELOPMENT OF RADIATION HARDENED LITHIUM-DOPED SOLAR CELLS Final Report
D. L. Kendall and R. A. Vineyard Jul. 1969 65 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952248)
(NASA-CR-108781; TI-03-69-37) Avail: CFSTI CSCL 10B

Two basic fabrication techniques were utilized on 600 1 x 2 cm cells. Variables investigated included lithium diffusion cycle and silicon crystal types. The solar cells were tested for conversion efficiency, short circuit current, and open circuit voltage under both tungsten and filtered-xenon light sources. Conversion efficiencies on lots 8, 9, and 10 averaged > 12.5% under the tungsten light source calibrated at 100 mW/sq cm sunlight equivalent intensity. Sample cells from lot 5 averaged 10.4% AMO under the filtered-xenon solar simulator. Although lithium is generally observed in silicon as the interstitial donor, lithium substitutional acceptors were identified and their concentrations measured. Heavily boron-doped silicon was compensated by lithium and the resultant resistivity (apparent) was determined as a function of time. The electrical characteristics (Hall mobility, lifetime, etc.) of lithium-diffused silicon were measured. Impurity diffusion in silicon is reviewed with respect to solar cell characteristics and radiation damage. Author

N70-20418*# Thermo-Electron Corp., Waltham, Mass.
PERFORMANCE OF CHEMICALLY VAPOR-DEPOSITED TUNGSTEN EMITTERS IN THERMIONIC CONVERTERS
C. C. Wang, F. Rufeh, and D. P. Lieb Nov. 1969 67 p refs
(Contract NAS3-9424)
(NASA-CR-72623; TE-4068-182-68) Avail: CFSTI CSCL 10B

The performance of tungsten, deposited from its halides by hydrogen reduction of hexafluoride (fluoride tungsten) and hexachloride (chloride tungsten), as emitters of thermionic converters was studied in six planar geometry converters with niobium collectors and an interelectrode spacing of 8 + or – 1/2 mils. The data are presented in the form of variable cesium temperature families and cover the emitter temperature range of 1600 to 2000 K. The results show that the maximum power achieved at a given emitter temperature with chloride tungsten emitters is higher than that achieved with fluoride tungsten emitters throughout the temperature range. For example, at an emitter temperature of 2000 K, the maximum power for chloride tungsten emitters is about twice that for fluoride tungsten emitters. It was also found that chemical etching of fluoride tungsten makes a considerable improvement in its performance. Author

N70-20429*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF DECREASING TEMPERATURE AND ILLUMINATION INTENSITY ON SILICON SOLAR CELL PERFORMANCE
Henry W. Brandhorst, Jr. and Russell E. Hart, Jr. Feb. 1970 36 p refs
(NASA-TM-X-52756) Avail: CFSTI CSCL 10B

Performance curves of nine silicon solar cells were obtained at simulated solar intensities of 136, 12.0, 4.6 and 2.7 mW/sq cm at temperatures between 115 and 330 K. Efficiencies of the cells ranged from 9.1 to 15.6 percent under simulated Jupiter conditions (4.6 mW/sq cm, 140 K). Three cells showed poor performance caused by a Schottky (metal-semiconductor) barrier at the rear contact. Five other cells showed a flat spot on the I-V curves at low temperatures which is related to a drop in efficiency under Jupiter conditions. Author

N70-20448*# Exotech, Inc., Washington, D.C.
SOLAR CELL PERFORMANCE MATHEMATICAL MODEL Quarterly Report, 1 Sep. –30 Nov. 1969
M. J. Barrett and M. B. Hornstein 15 Dec. 1969 23 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952246)
(NASA-CR-108933; TRSR-70-06; QR-2) Avail: CFSTI CSCL 10B

Results of the second three months of an effort to prepare a computer program for silicon solar cell performance in the space environment are reported. The previously completed mathematical model has been reviewed in the light of current research activity and improvements to the model flammable suggested. Numerical and graphic results of computations are provided. Author

N70-20539*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HEAT SOURCES FOR SPACE MANUFACTURING PROCESSES
John R. Rasquin *In its* Space Process. and Manufacturing 5 Feb. 1970 p 375-382 (See N70-20517 08-30)
Avail: CFSTI

This paper examines the various possible heat sources for manufacturing processes requiring heat in the environment of space and zero-G and makes a rough analysis of the usefulness of the heat sources with respect to weight, bulk, power requirements, reliability, safety of operation, and cost where applicable to any of the various manufacturing process experiments proposed for the AAP program. The analysis of the heat sources is not too detailed or accurate because not enough is known at this time about which materials are to be processed. This paper also assumes that a primary source of electric power is available. Author

N70-20586# Army Foreign Science and Technology Center, Washington, D.C.
DESIGN OF AIRCRAFT ELECTRIC POWER SUPPLY SYSTEMS
G. D. Vlasov 6 Nov. 1969 469 p refs Transl. into ENGLISH from the Russian
(AD-697985; FSTC-HT-23-259-69) Avail: CFSTI CSCL 10/2

The report describes the possible variations of aircraft electric power systems. It discusses the merits and faults of types of current, generators, equipment, conductors, drives. Numerous circuit diagrams show how to avoid catastrophy in case of failure of individual power sources, lines, convertors, etc. The most promising types and systems are recommended. An example of a draft of an airplanes power system is given. Author (TAB)

N70-20605# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
A FUEL CELL USING A FERRICYANIDE-FERROCYANIDE SYSTEM
Fujio Takahashi et al Oct. 1969 23 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi, (Japan), v. 70, no. 7, 1967 p 1075-1078
(Contract F19628-68-C-0251)
(AD-697843; EMM-69-226; AFCRL-69-0427) CSCL 10/2

To extend the study of fuel cells using glucose as the fuel, a Fe(CN)6(-4) - Fe(CN)6(-3) redox agent is substituted for the Mn(2+) -Mn3+ or Mn4+ system. It is thought that the former system is better than the latter because it consists of an anion which does not migrate to the cathode chamber and it shows lower oxidation reduction potential. To increase the cell voltage, H2SO4 and NaOH solutions are used as the catholyte and anolyte, respectively. A cation-exchange resin sheet is used as a bridge to lower the migration of anions. The results show that it is possible to use carbon as the oxygen electrode material and to obtain a high current density with it, that ferrocyanide is oxidized to Fe(CN)6(-3) at the anode, and that glucose is oxidized to CO2 and H2O in concentrated NaOH solution by Fe(CN)6(-3). Author (TAB)

N70-20620*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
INVESTIGATION OF FACTORS AFFECTING THE PERFORMANCE OF POROUS STRUCTURES USED AS OXYGEN FUEL CELL ELECTRODES Final Report, 1 Jul. 1968—8 Dec. 1969
T. Katan Dec. 1969 72 p refs
(Contract NAS3-11833)
(NASA-CR-108976; LMSC-N-3E-70-1) Avail: CFSTI CSCL 10B

Design methods are detailed for improving structures of oxygen electrodes. Prime emphasis is given to control of liquid distribution and configuration, best accomplished by using electrode structures which are well characterized. The critical role of a pendular-funicular transition state for correct internal liquid configuration is shown, together with its relation to design and performance. Experimental studies included a determination of synergistic effects with double-porosity structures and the necessity of catalyst placement toward the electrolyte side of the electrode. Gold was found to act suitably as an oxygen catalyst, and Teflon in the gas electrode acted as though imparting differential pressure to the system. Theoretical studies involved design recommendations for evaporating electrodes and the relation of structural parameters of porous systems. Author

N70-20627*# AiResearch Mfg. Co., Los Angeles, Calif.
RECUPERATOR DEVELOPMENT PROGRAM, SOLAR BRAYTON CYCLE SYSTEM Final Design Report
A. F. Anderson 19 Mar. 1968 270 p refs
(Contract NAS3-2793)
(NASA-CR-108945; HT-66-0207) Avail: CFSTI CSCL 10B

The results of all analytical and test work conducted during a program for the development of a recuperator to be utilized in a closed Brayton cycle space power system that uses solar energy as a heat source and argon as the working fluid are presented. The initial phase of the work was a parametric design study to determine the optimum recuperator operating conditions for the Brayton cycle. The study was followed by analysis and testing that was directed towards determining the final design configuration. The final phase of this program included fabrication and testing of a recuperator that was delivered to the NASA Lewis Research Center. A summary of the entire program is included. Author

N70-20628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL INTEGRATION OF A BRAYTON POWER SYSTEM WITH A LIFE-SUPPORT SYSTEM. PART 2: TRANSIENT ANALYSIS
Raymond S. Biliski Washington Mar. 1970 12 p refs
(NASA-TM-X-1966; E-5464) Avail: CFSTI CSCL 10B

An analytical study was conducted to determine the feasibility of integrating a Brayton power system with a four-man life-support system. As part of this study, an analog computer simulation of

the Brayton system was utilized to investigate the dynamic effect of the life-support-system varying heat load on the Brayton system. The dynamic effect of the life-support-system thermal load on the Brayton system was minimal. Author

N70-20762*# Tyco Labs., Inc., Waltham, Mass.
ALUMINUM CHLORINE BATTERY
Jose Giner and Gerhard L. Holleck Washington NASA Mar. 1970 61 p refs
(Contract NAS12-688)
(NASA-CR-1541) Avail: CFSTI CSCL 10C

A molten salt system based on Al and Cl2 carbon electrodes with an AlCl3-alkali chloride eutectic as electrolyte offers promise as a rechargeable, high energy density battery which can operate at a relatively low temperature and may withstand sterilization. To obtain pure AlCl3-KCl-NaCl melts, different commercial aluminum chloride materials were investigated. FeCl3 was found to be the major impurity of all of them. A procedure involving treatment of a melt of high AlCl3 concentration with magnesium powder prior to evaporation yielded pure AlCl3. AlCl3-KCl-NaCl melts using this material remained clear and showed practically no background current. Investigations of vitreous carbon electrodes show that carbon is intrinsically active for chlorine reduction in AlCl3-alkali chloride melts. A study of compatibility of carbon electrodes for chlorine in AlCl3 eutectics yielded carbon samples which appear suited for the construction of porous chlorine cathodes. Author

N70-20788*# McDonnell-Douglas Astronautics Co., Newport Beach, Calif. Astropower Lab.
DEVELOPMENT OF A RECHARGEABLE ZINC-OXYGEN POWER SYSTEM Final Report, Jun. 1968 – Oct. 1969
H. A. Frank Oct. 1969 70 p refs
(Contract NAS3-11832)
(NASA-CR-72636; DAC-61002-F) Avail: CFSTI CSCL 10C

The performance of rechargeable zinc-oxygen cells employing inorganic separators is described. Experimental cells were evaluated at 500 p.s.i.g. (35.1 kg./sq. cm.) and at ambient temperature on a continuous 6-hour cycle regime at 25% depth of discharge. Cells with the most promising components operated effectively for over 200 cycles (1200 hours). A hydrogen problem was noted and is discussed in detail. Author

N70-20797# Gulton Industries, Inc., Metuchen, N.J.
CYCLE LIFE TESTING OF VENTED, RECHARGEABLE SILVER-CADMIUM CELLS Final Report, Sep. 1968-Jun. 1969
S. Charlip and H. N. Seigner Sep. 1969 27 p refs
(Contract DA-36-039-AMC-03359(E))
(AD-697863; ECOM-03359-F) Avail: CFSTI CSCL 10/3

The objectives of this program was to cycle life test vented silver-cadmium cells, in four sizes with a common base area. The rated cell capacities, at the five-hour discharge rates, were: 7.0 ampere-hours, 15.0 ampere-hours, 22.0 ampere-hours, 31.0 ampere-hours. The report gives the cell capacities for each of the 112th manual discharge cycles, following 110 successive automatic and one manual cycle at 62-1/2% depth of discharge. The automatic cycling regime consisted of a 6 hour orbit, 3-1/2 hours of charging, and 2-1/2 hours of discharge. The report gives data on cell capacities for a total of 1008 cycles. Author (TAB)

N70-20925*# Melpar, Inc., Falls Church, Va.
INVESTIGATION OF SOLID STATE ELECTROLYTE SILVER-ZINC BATTERY Quarterly Report, 1 Jun.-1 Sep. 1969
1 Sep. 1969 31 p
(Contract NAS5-21033)
(NASA-CR-109084; QR-1) Avail: CFSTI CSCL 10C

The purpose is to determine the mechanism of current flow in the solid electrolyte, rechargeable silver-zinc electrochemical cell. This system employs a solid electrolyte comprising zinc chloride diammine, $ZnCl_2 \cdot 2NH_3$. The identity and purity of the starting materials and some of the products formed during operation was identified. The effect of moisture on the performance of the cell was studied with rather inconclusive results to date. Author

N70-21052# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
THE USE OF A HYDROGENASE-METHYLENE BLUE SYSTEM IN A BIOCHEMICAL FUEL CELL (AN ANODE REACTION)
Jun Mizuguchi et al Bedford, Mass. AFCRL Oct. 1969 11 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 67, no. 2, 1964 p 410
(Contract F19628-68-C-0251)
(AD-697841; Emm-69-223; Trans-60; AFCRL-69-0431) Avail: CFSTI CSCL 10/2

An electron carrier system similar to one found in living cells has been studied in vitro at the anode of a biochemical fuel cell. The action of an electron carrier system, composed of methylene blue as an organic redox compound and hydrogenase as an enzyme with hydrogen gas, has been analyzed at the anode of a biochemical fuel cell. A current of 0.16 mA/(sq. cm.) has been shown using a hydrogenase solution obtained from E. coli. It gave evidence for general application of similar systems in biochemical fuel cells. Further experimentation will be directed to obtain higher current-voltage by other enzyme-like substances. Author (TAB)

N70-21053# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
BIOCHEMICAL FUEL CELLS
Shuichi Suzuki Bedford, Mass. AFCRL Oct. 1969 31 p refs Transl. into ENGLISH from Kagaku to Kogyo (Tokyo), v. 17, no. 12, 1964 p 1359-1365
(Contract F19628-68-C-0251)
(AD-697842; Emm-69-221; Trans-58; AFCRL-69-0428) Avail: CFSTI CSCL 10/2

Studies on fuel cells which attempt to extract and recover the energy generated by the burning of fuel in the form of electrical energy are presently being vigorously pursued. One of the most promising approaches seems to be the utilization of the cells employing a gas such as oxygen or hydrogen as an electrolytically active substance. Biochemical fuel cells which use organic materials or simple inorganic salts as fuel and convert chemical energy into electrical energy are also being investigated. In the latter case, reactions at both anode and cathode are designed to be carried out catalytically by biochemical methods closely paralleling redox reactions. It is recognized that the biochemical energetics characteristic of living systems may be heuristically interpreted as examples of energy generation. In particular, the energy reactions of the electron carrier system found in organisms may be so analyzed. A review is presented of the pertinent experimental literature. Author (TAB)

N70-21067 National Lending Library for Science and Technology, Boston Spa (England).
THE DISCHARGE OF ELECTROCHEMICAL POWER SOURCES AT CONSTANT CURRENTS
B. V. Bafyaev 20 Aug. 1969 12 p Transl. into ENGLISH from Elektrotechnika (Budapest), no. 3, 1968 p 35 – 38
(NLL-Trans-2577-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupon

The basic equations for calculating the discharge of electrochemical storage batteries at a constant rate are derived and the influence of the variation of other parameters are shown. The charge capacity of the batteries at different temperatures are calculated and compared with experimental data. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-19731*# California Univ., Los Angeles. Space Biology Lab.
EFFECT OF LOW-LEVEL, LOW-FREQUENCY ELECTRIC FIELDS ON EEG AND BEHAVIOR IN MACACA NEMESTRINA
R. J. Gavalas, D. O. Walter, J. Hamer, and W. Ross Adey [1969] 23 p refs
(Grant NGR-05-007-195; Contract DADA-17-67-C-7124; Grant NIH FR-3)
(NASA-CR-108247; M-2096) Avail: CFSTI CSCL 06C

A series of experiments has been done to assess the effects of low-level, low-frequency electronic fields on the behavior and EEG of monkeys. Three monkeys were implanted with subcortical and cortical EEG electrodes and trained to press a panel on a fixed interval-limited hold schedule. The monkeys were rewarded for pressing the panel once every five seconds within a 2.5-second enable period. After the animals were performing well, they were tested under low-level electric fields (2.8 volts p-p). Fields frequency was set at 7 or 10 Hz, within the range of typical EEG recording (0-33 Hz). Four-hour daily tests of field on were randomly interspersed with four-hour runs with fields-off. Under the 7-Hz fields, the monkeys showed a significantly faster interresponse time in 5 of 6 experiments. Analysis of the EEG data showed a relative peak in power at the frequency of the fields (10 Hz and 7 Hz) for the hippocampus in all three monkeys. Similar peaks were seen less consistently in the amygdala and the centre median. Author

N70-19772*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 7 TO 11: MEDICAL CONCERNS AND RESULTS
Charles A. Berry Nov. 1969 64 p refs Presented at the 18th Intern. Congr. of Aerospace Med., Amsterdam, 18 Sep. 1969
(NASA-TM-X-58034) Avail: CFSTI CSCL 06E

The medical task required confirmation of the Gemini findings and definition and solution of any probelms encountered in the four Apollo flights prior to the Apollo 11 lunar landing. The medical concerns included the following: (1) The effect of decreased red blood cell mass and decreased exercise capacity and of cardiovascular deconditioning on the ability of the crew to do lunar-surface activity; (2) the capability to work effectively in one-sixth g and the energy cost of such work; (3) the ability to get adequate rest and sleep in flight and on the lunar surface; (4) the prevention of preflight, inflight, and postflight illness by proper preventive medicine; (5) the possible development of motion sickness of vestibular origin; and (6) the conduct of a postflight quarantine of crew and lunar samples. Author

N70-19774*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.
THE EFFECT OF SONIC BOOM EXPOSURE TO THE GUINEA PIG COCHLEA
Deborah A. Majeau-Chargois 29 Oct. 1969 17 p refs
(Grant NGL-19-001-068)
(NASA-CR-102461) Avail: CFSTI CSCL 06S

Thirty guinea pigs with normal hearing were used. Six were controls and eight each were exposed to 1000 sonic booms at approximately 130 dB of 2, 4.76, and 125 msec N-wave pulse duration, respectively. The cochleae were dissected, stained with osmium tetroxide, and the organ of Corti removed for histological examination. It was observed that hair cell damage occurred in the apical turn of the cochleae of the exposed guinea pigs while the other turns were unaffected. Damage occurred in the same place with all pulse signatures tested. Author

N70-19779# Advisory Group for Aerospace Research and Development, Paris (France).
MEASUREMENT OF AIRCREW PERFORMANCE: THE FLIGHT DECK WORKLOAD AND ITS RELATION TO PILOT PERFORMANCE
Dec. 1969 106 p refs Presented at Symp. held by Aerospace Med. Panel of AGARD at Brooks AFB, Tex., 14-15 May 1969
(AGARD-CP-156) Avail: CFSTI

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N70-19780# Board of Trade, London (England). Civil Aviation Dept.
FLIGHT-DECK WORKLOAD STUDIES IN CIVIL TRANSPORT AIRCRAFT
J. S. Howitt *In* AGARD Meas. of Aircrew Performance Dec. 1969 (See N70-19779 08-04) 9 p
Avail: CFSTI

The term "Work Load Study' can be interpreted in many ways depending on one's particular interest and point of view. During the past four years a small team has been conducting field studies in civil airlines during both long-haul and short-haul operations. The team have found such studies can be conveniently divided into three main areas: (1) that associated with short term, or instantaneous work load; (2) that associated with accumulated effects of work loads over a particular period; and (3) that associated with the total working environment. Some of the methods used and the indications for further areas of research are discussed. Author

N70-19781# Army Aeromedical Research Unit, Fort Rucker, Ala.
ENERGY COST OF PILOTING FIXED AND ROTARY WING ARMY AIRCRAFT
Delvin E. Littell *In* AGARD Meas. of Aircrew Performance Dec. 1969 6 p (See N70-19779 08-04)
Avail: CFSTI

The energy cost of piloting three Army helicopters (light, utility and medium) and one utility fixed wing aircraft was investigated. Energy expenditure was calculated from expired minute volume and expired air oxygen content measured during the basal state and in normal flight conditions. Data were collected on a total of sixteen pilots, five of whom flew all three helicopters. All of the

helicopter pilots were experienced test pilots. The data indicate that, for these pilots, and flying conditions studied, the energy cost must be classed as very light work, averaging 1.79 kcal/minute. The energy cost of flying the fixed wing aircraft by less experienced pilots was similar to previously reported energy expenditures for such aircraft. The data were segregated to separate measurements made at altitude from those made during flight in close proximity to the ground. In three of the four aircraft, the pilot's energy expenditure was greater when ground contact was possible. Author

N70-19782# Aberdeen Proving Ground, Md. Systems Research Lab.

PSYCHOMOTOR PERFORMANCE UNDER THERMAL STRESS: A CRITICAL APPRAISAL

R. Douglas Jones *In* AGARD Meas. of Aircrew Performance Dec. 1969 16 p refs (See N70-19779 08-04)

Avail: CFSTI

The increasing demand for design standards applicable to crew station thermal environments would seem to necessitate some modification of approach in future thermal stress research. In general, changes in the basic research strategy should include: (1) adoption of a standardized index representing all relevant environmental parameters acting to produce what is now loosely termed "heat;" (2) investigation of those thermal conditions expected to obtain in the predicted operational environment for a given man-machine system; (3) greater emphasis on psychological variables such as learning, motivation and personality as they interact with both environmental and task variables; (4) a new definition of "stress" in terms of changes in a subject's ability to perform a given task rather than his physiological adaption; and (5) increased attention to the kinds of increasingly complex performance demanded of the human operator in modern man-machine systems. Author

N70-19785# Royal Aircraft Establishment, Farnborough (England).

PHYSIOLOGICAL ASSESSMENT OF PILOT STRESS DURING LANDING

K. G. Corkindale and F. G. Cumming, and A. M. Hammerton-Fraser (RAF Inst. of Aviation Med., Farnborough, England) *In* AGARD Meas. of Aircrew Performance Dec. 1969 5 p refs (See N70-19779 08-04)

Avail: CFSTI

A physiological recording system was developed for installation in a fairly large aircraft. Basically, the system reduced a set of physiological measurements into cumulative digital form which were photographically recorded at ten second intervals. The measurements taken were: (1) integrated arm muscle activity; (2) integrated leg muscle activity; (3) skin resistance activity; (4) respiratory rate; (5) respiratory flow; (6) end tidal carbon dioxide; and (7) heart rate. After testing in laboratory conditions the system was transferred to a rack in the forward passenger cabin of a Comet jet transport aircraft for the program being undertaken by the Blind Landing Experimental Unit at that time involved landing with or without Autoland facilities either completely blind or in various degrees of fog conditions. Author

N70-19787# Aberdeen Proving Ground, Md. Systems Research Lab.

EXPLORATORY STUDY OF PILOT PERFORMANCE DURING HIGH AMBIENT TEMPERATURES/HUMIDITY

Stephen Moreland and John A. Barnes *In* AGARD Meas. of Aircrew Performance Dec. 1969 26 p refs (See N70-19779 08-04)

Avail: CFSTI

Stepwise multiple-regression program, Pearson correlation, analysis of variance and t tests of significance were employed on data to describe the relationships of temperature changes with pilot performance factors. The following statements generally summarize the results of the study: (1) pilot performance decreased and performance variability increased above a wet bulb globe temperature index of 85 F; (2) the predictor performance equations determined by the multiple-regression program indicated that skin and rectal temperatures were highly related to pilot performance; (3) pilot's reaction times increased as either ambient temperatures or rectal temperatures increased; (4) pilots performed better when they encountered light to moderate aircraft turbulence than they did on non-turbulent flights; (5) pilot subjective judgments of cabin heat were highly inconsistent with environmental measurements; (6) weight loss from perspiration appeared to have a positive correlation with performance; (7) the clothing and equipment configurations worn by the pilots had no significant effect on their performance; (8) the cabin heat did not significantly affect the pilots' ability to observe ground targets; (9) large differences in performance variability among pilots were due to basic pilot techniques; and (10) no constant relationship could be determined between ground and airborne measures of wet bulb globe temperature. Author

N70-19831*# John B. Pierce Foundation of Connecticut, New Haven.

EXPANSION OF A MATHEMATICAL MODEL OF THERMOREGULATION TO INCLUDE HIGH METABOLIC RATES Final Report, 19 Jun. 1968 – 18 Jun. 1969

J. A. J. Stolwijk 18 Jun. 1969 120 p refs

(Contract NAS9-7140)

(NASA-CR-102192; FR-8) Avail: CFSTI CSCL 06P

Working muscle temperature during work at various levels and different ambient temperatures was obtained. An experimental study of on and off transients of exercise at levels of 25, 50, and 75 percent aerobic capacity and at ambient temperatures of 10, 20, and 30 deg C is discussed, along with a theoretical study with the mathematical model of thermoregulation, involving the structure and coefficients of the regulatory portion of the model. J.A.M.

N70-19834*# American Inst. for Research, Palo Alto, Calif. Social and Educational Research Program.

A STUDY IN IMPROVING PERFORMANCE OF COMPLEX TASKS Final Report

Lloyd O. Brooks Jan. 1970 58 p refs

(Contract NAS2-3916)

(NASA-CR-73418; AIR-649-1/70-FR) Avail: CFSTI CSCL 05J

Laboratory experiments were conducted, with college students as subjects, in which contingencies of reinforcement were the experimental treatments. Speed and correctness of responses to instructional items were the dependent variables. Subjects participated individually, completed the first 142 items of a psychology program under a baseline condition, the next 489 items under one of the experimental treatments, and then responded to a posttest. A goal of the experiments was to identify procedures for improving performance of complex tasks. Subgoals were the development of techniques for accurately predicting later performance impairment from an early, pretreatment, sample of response times and the development of procedures for increasing performance speed without reducing correctness. In achieving the first subgoal, later impairment was defined in terms of the number of posttest errors on the posttest which followed the experimental treatment. Statistically significant predictions (multiple R's in excess of 0.5, cross validated with two samples of 35 subjects) were obtained on the basis of response times from three instructional items (selected from among the first four dozen at the beginning of baseline). That is, subjects who responded quickly to these instructional items made fewer posttest errors. Those who responded slowly made more. Author

N70-19858*# Pennsylvania State Univ., University Park. King of Prussia Graduate Center.

DESIGN AND TESTING OF A HEAT TRANSFER SYSTEM IN THE CONSTANT NUSSELT NUMBER RANGE

Walter Kugler (M.S. Thesis) Mar. 1970 85 p

(Contract NAS2-1900)

(NASA-CR-73379) Avail: CFSTI CSCL 06S

This paper presents the thermal control subsystem design for the primate mission of the biosatellite program. A subsystem is described that provides temperature control for the fuel cell power source, cryogenic gases, miscellaneous liquids and the gas management assembly. The latter provides control of the gaseous environment in the primate compartment. The trade-offs to determine the subsystem and component requirements are presented as are component, subsystem breadboard and system thermal vacuum test results. The component test program verified that all components met their requirements with the exception of one heat exchanger. Fortunately, the system requirements could be and were relaxed. The subsequent breadboard and system thermal vacuum tests verified that the thermal control subsystem met all of the system requirements. Author

N70-19897# California Univ., San Francisco. School of Medicine.
ANALYSIS OF VOCAL BEHAVIOR Final Report, 1 May 1965 – 30 Jun. 1969
John A. Starkweather Jul. 1969 81 p refs
(Contract Nonr-3656(28))
(AD-698142) Avail: CFSTI CSCL 17/2

The research had as its objectives: (1) To develop acoustic measures of the voice to provide a useful monitor of the behavioral and emotional state of a speaker who is using a voice communication channel. (2) To explore and develop computer programs for pattern recognition of complex acoustic data to enable rapid processing, feedback of results, and adjustment of parameters for further work, and (3) To investigate the feasibility of equipment for the assessment of the behavioral state of personnel located at remote locations. A spectrum analyzer was developed appropriate to obtain time-averaged acoustic spectra of continuous speech which is converted into digital form for data reduction and analysis by off-line computer. The report describes the instrumentation developed for acoustic analysis and its connection to a computer providing graphic display and digital magnetic tape, the use of this tape on a larger computer for statistical analysis and an investigation of similarity of results with previous work. Author (TAB)

N70-19926*# Colorado State Univ., Fort Collins.
STIMULATION OF CARDIOVASCULAR ADAPTABILITY DURING PROLONGED SPACE EXPOSURE
Harry A. Gorman *In its* Biol. and Eng. of Space and Planetary Life Systems Sep. 1969 8 p (See N70-19925 08-34)
Avail: CFSTI CSCL 06S

Cardiac output during intermittent venous pooling of blood by a sequential ripple sleeve system was studied on primates. The tranquilized animals were fitted with arm and leg sleeves and subjected to lower extremity venous pooling. Electronic monitoring of the physiological parameters of their cardiovascular systems showed that activation of the ripple sleeves, from the extremities toward the heart, accelerated venous blood return to the central circulation and decreased blood volume in the extremities. G.G.

N70-20040# North American Rockwell Corp., Downey, Calif. Space Div.
A STUDY OF WORK-PRODUCING CHARACTERISTICS OF UNDERWATER OPERATIONS AS A FUNCTION OF DEPTH Final Report, May-Nov. 1969
I. Streimer 29 Nov. 1969 48 p refs
(Contract N00014-67-C-0363)
(AD-697937; SD-69-712) Avail: CFSTI CSCL 6/19

The effects of alterations in working depth upon the work-producing characteristics of human performing specific underwater manual tasks were examined. The tasks were: (1) A simple, repetitive rotary task requiring continuous torque production against a fixed resistance in a self-paced manner; and (2) A simple, repetitive, discontinuous flexion/extension task requiring the exertion of linear forces against a fixed resistance in a self-paced manner. The work was performed at two depths, 33 and 66 feet in the open ocean. During work sessions, heart rate and three skin temperatures were recorded. Similarly, techniques were employed which allows measurement of mean respiratory flow volumes and oxygen uptake level. The results obtained were examined as functions of task and depth. Statistically significant performance differences were found and related to previous study results. Author (TAB)

N70-20058 Kent State Univ., Ohio.
ROLE OF SIGNAL ONSET IN SOUND LOCALIZATION
David Russell Perrott (Ph.D. Thesis) 1968 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-9568

A sound field analysis was performed to determine the transient interaural time and intensity differences in the sound wave patterns arriving at the ears of a human listener. The results of this analysis indicated that transient audio-signal states cannot be adequately defined on the basis of the speed of sound and the interaural distance difference alone. Transient differences were calculated on the basis of signal onset rate and headshadow effects. These correction factors appear necessary in a description of signal arrival to a biological system having an absolute threshold for audio-signals. Tests of localization precision were made on four human listeners as a function of signal frequency and signal onset duration. Localization precision was determined with a minimum audible angle procedure (MAA). MAA was defined as the minimum angular separation of two sound sources which could be detected 75 percent of the time. The Method of Constant Stimuli was used in a two alternative forced choice task. MAA was observed to be largest for the 2000 Hz signal, smaller for the 5000 Hz signal, and smallest for the 500 Hz signal. Onset duration was an effective variable only for the 2000 Hz signal. For this signal, changes in MAA were directly related to onset duration. These changes were in turn related to the changes in the transient interaural intensity differences. Dissert. Abstr.

N70-20070*# National Aeronautics and Space Administration, Washington, D.C.
BIOLOGY
In its Rept. to COSPAR, French Space Program Feb. 1970 p 89-86 refs (See N70-20064 08-30)
Avail: CFSTI

Several important aspects of space biology are discussed, and include the following: experiments with black animals, quantitative studies of the biological effects of heavy cosmic radiation ions, pulmonary circulation and cutaneous circulation, continuous determination of the pulmonary artery flow and the cartid flow, continuous measurement of partial oxygen pressure in the arteries and veins, acceleration tolerance experiments with an animal carrying cardiovascular indicators, implantation of bipolar electrodes in the bulbar protuberance region, miniaturization of a gamma detector, and achievement of isotopic radiocardiographs. Author

N70-20098 Case Western Reserve Univ., Cleveland, Ohio.
THE EFFECTS OF PHYSIOLOGICAL NOISE ON THE AUDITORY THRESHOLD
Linda Kathrine Moulin (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-9363

The present study investigated the effects of physiological noise on two aspects of auditory threshold responses: the slope of the psychometric function and the occurrence of false positive responses. In addition, information concerning the origin of physiological noise and the frequency characteristics of the noise was obtained. An internal noise model of auditory functioning was proposed. Psychometric function slopes and false positive rates were obtained from three groups of subjects: those with normal hearing, those with blockage of the external auditory canal, and a group exhibiting otosclerotic hearing losses. The two criterion measures were determined for each of three frequencies: 80, 125, and 1000 Hz in unmasked and masked (50 dB SL white noise) conditions. Dissert. Abstr.

N70-20178 Syracuse Univ., N.Y.
DIELECTRIC AND PARAMAGNETIC RESONANCE PROPERTIES OF BONE
Andrew Anthony Marino (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7760

The dielectric constant of human cortical bone having water contents from 0 to 72 mg H_2O/g-bone has been measured. From an analysis of the variation of the dielectric constant with water content a determination was made of the amount of water associated with bone that exists in the primary bound state. A difference in dielectric behavior is seen between normal and pathological bone. The Electron Paramagnetic Resonance (EPR) spectrum of bone at room temperature is found. From an analysis of the EPR spectrum of the cupric ion adsorbed on collagen and bone mineral from solution it is concluded that there are sites of essentially identical crystalline field symmetry located on each of the two materials. The possible importance of this in bone formation is discussed. Dissert. Abstr.

N70-20222# Clemson Coll., S.C. Dept. of Electrical Engineering.
CONCEPT FORMULATION AS A BASIS FOR PATTERN RECOGNITION
Robert W. Snelsire 1969 15 p refs
(Contract N00014-69-C-0232)
(AD-697973) Avail: CFSTI CSCL 6/4

The problem of designing computer programs which will approach human capabilities in pattern recognition is discussed. The fact that human beings are very good at recognizing patterns which are highly structured and very bad at recognizing patterns which are not is contrasted with the fact that the performance of computer systems is almost independent of the amount of structure in the patterns. It is then suggested that those visual concepts are developed by human beings which are useful for solving the structured pattern recognition problem. To gain insight into the way these visual concepts may be programmed, a simple game playing environment is proposed in which the winning patterns may be changed. A program will then be written which will perform as nearly as possible the way humans do -- well for structured patterns and badly for unstructured ones. A computer program to implement this game has been written and is briefly discussed, but the main purpose of this paper is to point out directions for research which may prove fruitful in solving some of the many difficult problems in pattern recognition. Author (TAB)

N70-20284# Bern Univ. (Switzerland). Toxic Hazards Div.
ELECTRON MICROSCOPIC AND MORPHOMETRIC STUDY OF MONKEY AND DOG LUNGS EXPOSED TO BERYLLIUM-CONTAINING DUST Final Report, Nov. 1967-Dec. 1968
Carmen R. Conradi, Yusuf Kapanci, Ewald R. Weibel, and Roger L. Sopher (Aerospace Med. Res. Lab.) Aug. 1969 21 p refs
(Contract AF 61(052)-68-C-0030)
(AD-695486; AMRL-TR-69-45) Avail: CFSTI CSCL 6/5

Five monkeys and six dogs were exposed three times for 30 minutes each at monthly intervals to an atmosphere contaminated by a beryllium compound whose chief component was beryllium oxide. Two years after the exposure, the lungs of both test groups, as well as those of two control monkeys and two control dogs, were fixed and prepared for electron microscopic and morphometric analysis. Histologic examination revealed no fibrotic changes of pulmonary parenchyma in the exposed animals. The ultrastructure of lung tissue of exposed animals was identical to that of control animals in every respect. Neither the arithmetic nor the harmonic mean thickness of the air-blood-barrier were changed in the test animals; in particular it was not possible to demonstrate edematous or proliferative changes. It is concluded from the electron microscopic and morphometric examination of these lungs, that the beryllium compound investigated, essentially beryllium oxide, has not caused any pathological alterations in lung tissue two years after exposure. Author (TAB)

N70-20342 Yale Univ., New Haven, Conn.
BODY CUES IN ADAPTATION TO TILTED VISION
Donald Michael Quinlan (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-8411

Recent studies on adaptation to spatially transformed vision raised questions about the effect of viewing the body during exposure to the altered vision. Sixty male undergraduates were exposed to a 15 deg optical rotation (tilt) of the visual field for twenty minutes. Six treatment conditions were formed, composed of two levels of activity and three levels of viewing of the body. Active subjects walked during the exposure period; passive subjects were moved on a dolly. Both active walking movement and viewing of all or part of the body resulted in greater amounts of adaptation to visual tilt. Apparent vertical and body axis differed slightly but showed the same direction of effects for activity and body-viewing. The tactual-kinaesthetic measure revealed no adaptation. All subjects, regardless of treatment condition, tended to show that external visual cues such as the luminous frame had more influence on the judgment of vertical. Dissert. Abstr.

N70-20352# Randomline Inc., Willow Grove, Pa.
EFFECTS OF MICROWAVES AND RADIO FREQUENCY ENERGY ON THE CENTRAL NERVOUS SYSTEM
Allan H. Frey 17 Sep. 1969 12 p Presented at the Symp. on the Biol. Effects and Health Implications of Microwave Radiation, Richmond, 17-19 Sep. 1969
(Contract N00014-69-C-0181)
(AD-698195) Avail: CFSTI CSCL 6/16

The history of research in this area is briefly sketched, sources of misunderstanding and confusion are identified, the writers own experimentation is briefly outlined, and critical matters that an experimenter must recognize are defined. Author (TAB)

N70-20354# Naval Submarine Medical Center, Groton, Conn. Medical Research Lab.
A DETERMINATION FOR THE NAVY OF ZERO HEARING LEVEL FOR SPEECH
James F. Willott 25 Jul. 1969 10 p refs
(AD-697932; SMRL-MR-69-7) Avail: CFSTI CSCL 6/16

Twenty-three normal-hearing candidates for the Submarine Force were examined for Speech Reception Threshold (SRT) by speech audiometry using phonetically-balanced (PB) lists of monosyllables instead of the usual spondee words. Such PB words are felt to be considerably better in assessing the important frequency regions for daily speech communication, namely, 500-2000 cycles per second. The Navy threshold for SRT(PB) is 25 db sound pressure level re 0.0002 dyne/sq cm, or 6 db higher than the standard SRT(Spondees). A standard speech audiometer, now calibrated for spondees according to USA Standards Institute specifications, can then be used with the PB lists by subtracting 6 db from the Hearing Level dial reading to arrive at the particular subjects SRT(PB). Author (TAB)

N70-20382# Argonne National Lab., Ill.
BIOLOGICAL AND MEDICAL RESEARCH DIVISION Annual Report, 1968
Dec. 1968 338 p refs
(Contract W-31-109-eng-38)
(ANL-7535) Avail: CFSTI

Papers are included on microbial genetics, developmental biology, mechanisms of carcinogenesis, radiation protection, cellular and somatic effects, theoretical biology, characterization of the Argonne National Laboratory beagle, laboratory animal medicine, biophysics, cellular biochemistry, enzymology, isotope studies, cellular fine structure, plant radiobiology, and growth and development of plants in compensated gravitational, magnetic, and electrical fields. A list of staff publications and an author index is included. NSA

N70-20389# Ohio State Univ., Columbus. Dept. of Speech.
RELATIVE PERCEPTUAL SIMILARITY OF SIXTY INITIAL CONSONANTS

John W. Black Nov. 1969 33 p refs
(Contract N00014-67-A-0232-0003)
(AD-698205; TN-1) Avail: CFSTI CSCL 17/2

The study reported treated the relationship among 59 consonants and consonantal clusters plus the instance of the absence of an initial consonant; a total of 60 manners of commencing one-syllable words. The 60 ways of beginning one-syllable words were nearly exhaustive except that initial vowel sounds were not compared. The results of the study confirm the earlier approach (direct magnitude estimation) as one that can be used in assigning degrees of similarity-dissimilarity to initial consonants and clusters. Values obtained in this manner can be subjected satisfactorily to factor analysis. The outcome suggests that place of articulation, stop-continuant features, degrees of friction, and glide-like aspects of consonants contribute importantly to grouping the consonants on the basis of similarity. A number of applications of the results seem possible and are in prospect. The grading of aural material to facilitate speech perception has many ramifications; for example, in code-words and auditory training. Author (TAB)

N70-20527*# National Aeronautics and Space Administration, Washington, D.C.
THE INTERACTION OF LIVING SYSTEMS WITH THE SPACE ENVIRONMENT
Joseph F. Sanders *In its* Space Process. and Manufacturing 5 Feb. 1970 p 195-215 (See N70-20517 08-30)
Avail: CFSTI

It was found that weightlessness altered the orientation as well as the growth of plants. Bacteria, insects and plants exposed to gamma radiation while weightless confirmed that neutralization of gravity does change the effects of radiation on the cellular elements that control heredity. The effects were significantly selective. Greater damage occurred to unpaired chromosomes such as the "X" or male chromosome. The primate showed physiologic deterioration attributed, mainly, to 8-1/2 days of weightlessness. Changes occurrad in central nervous system function, cardiovascular performance, fluid and electrolyte metabolism and circadian rhythms. Author

N70-20529# Martin Marietta Corp., Denver, Colo.
INDUSTRIAL MICROBIOLOGICAL APPLICATIONS IN ZERO GRAVITY: A VACCINE SATELLITE PROGRAM (VACSAT)
Russell T. Jordan *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 238-251 refs (See N70-20517 08-30)
Avail: CFSTI

The data from biosatellite experiments clearly show that bacterial cultures grown in a liquid medium produce significantly larger populations and have higher growth rates, as a result of space flight, than do identical control cultures on Earth. This paper will discuss some potential applications for manufacturing pharmaceuticals in an "Orbital Work Shop" and present a preliminary design for a "Zero G Fermenter" with a proposed method for the unprecedented utilization of weightlessness in industrial fermentation. Author

N70-20663# Columbia Univ., New York. Radiological Research Lab.
RESEARCH PROJECT Annual Report, 1 Jan. 1969
1 Jan. 1969 379 p refs
(Contract AT(30-1)-2740)
(NYO-2740-6) Avail: CFSTI

The reports are divided into sections including; dosimetry, measurements of microscopic distribution of radiation energy, radiation protection, ancillary problems, biophysics, and radiobiology. A bibliography is included. NSA

N70-20685*# National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Jan. 1970 203 p
(NASA-SP-7011(71)) Avail: CFSTI CSCL 06C

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N70-20686*# California Univ., Davis. Bioastronautics Lab.
ORBITAL FLIGHT EFFECTS ON CALCIUM KINETICS AND FRACTURE HEALING Final Report
John R. Beljan, Richard L. Bell, Russell R. Burton, Marvin Goldman, Frank H. Kratzer et al 15 Feb. 1970 162 p refs
(Contract NAS2-5245)
(NASA-CR-73423) Avail: CFSTI CSCL 06S

Any determination of the effects of an environmental or nutritional perturbation on normal calcium homeostasis requires a basic understanding of some of the mineral kinetics of the system under study. In the avian model used, in studying the effects of weightlessness on skeletal quality, repair of calibrated osteotomies in weightlessness as well as at 1-'G' will include a quantitative evaluation of the dynamics and source of mineral utilized in bone repair. It should be emphasized that this experiment was to characterize the calcium dynamics of the avian model in our standard laboratory environment, at normal gravity, on a normal diet and in an unstressed condition. The object of this study was to determine the rate and degree of blood calcium exchange, using simple isotope dilution techniques, and to obtain a preliminary estimate of the fractorial skeletal uptake of a labeled pulse of blood calcium. Author

N70-20785*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANTIOXIDANT REQUIREMENTS OF RATS EXPOSED TO 100% OXYGEN. PART 2: EFFECTS OF DIETARY ASCORBIC ACID
Anne M. Shaw, Daniel B. Menzel, and Gerald A. Brooksby [1969] 24 p refs Prepared in part by California Univ., Berkeley
(Grant NGR-05-003-090)
(NASA-TM-X-62817) Avail: CFSTI CSCL 06C

Young male Sprague–Dawley rats fed diets containing various combinations of vitamins E and C were continuously exposed to oxygen at 600 mm Hg for 4 weeks. Gain and food efficiency ratios of exposed rats fed diets lacking either vitamin E or C were significantly lower than those of their pair-fed controls. The addition of 750 mg ascorbate/kg to the diet containing vitamin E tended to improve gain and FER of exposed rats, while 1500 mg/kg appeared detrimental. The addition of 750 or 1500 mg ascorbic acid/kg of diet increased the blood ascorbic acid in both exposed and control rats, and decreased the difference between the oxygen-exposed rats and their pair-fed controls. Liver vitamin A was not affected by oxygen exposure in any of the diet groups, but in one of the experiments plasma vitamin A was depressed in exposed rats fed diets containing ascorbic acid compared to their pair-fed air controls. No consistent difference in liver catalase activity was observed in exposed rats and pair-fed controls, suggesting that other means of H_2O_2 removal may be more important for the oxygen-exposed animal. Author

N70-20841*# California Univ., Berkeley.
INVESTIGATION OF THE ROLE OF SELENIUM IN THE NUTRITION AND PHYSIOLOGY OF NEURAL TISSUES OF CHICKENS AND TURKEYS
C. M. Johnson, W. O. Wilson, and L. Z. McFarland Jan. 1970 17 p refs
(Contract NAS2-4915)
(NASA-CR-73422) Avail: CFSTI CSCL 06C

Endogenous selenium concentrations in selected tissues of chicken, turkey and coturnix are presented. The selenium concentration for laying chicken organs and tissues were variable and in decreasing order as follows: pineal, pituitary, kidney, spleen, egg yolk, liver, pancreas, magnum, cerebrum, diencephalon, cerebellum, blood, ovary and pectoral muscle. The order for turkey organs was similar except that for pineal which was much lower and similar in concentration to the ovary. In coturnix the order was similar except the pineal had a very low concentration of selenium similar to the cerebellum and the pancreas had a high concentration exceeding that of the pituitary. Author

N70-20929# Army Medical Research and Nutrition Lab., Denver, Colo.

CARDIAC SIZE AND PULMONARY HYPERTENSION IN DOGS EXPOSED TO HIGH ALTITUDE

J. A. Vogel, R. L. Genovese, T. L. Powell, G. W. Bishop, T. J. Bucci et al Oct. 1969 28 p refs

(AD-697714; USAMRNL-322) Avail: CFSTI CSCL 6/19

Studies were conducted to determine whether the canine heart develops typical hypertrophy when subjected to high altitude exposure. Groups of six or eight purebred adult beagles were examined at sea level, after 16 weeks at 5,380 ft and after 6 and 16 weeks at 14, 110 ft. Weight of ventricles and septum, expressed as absolute weight or as a ratio to body weight, was unchanged after 16 weeks at 5,380 ft. In those dogs held for 16 weeks at 14,110 ft the septal weights were less than those of the sea level controls. Ventricular weight and ratios of weights of the left and right ventricular components to the total ventricular weight were unaltered. Lack of any hypertrophy was further confirmed by ECG and angiography. Despite doubling of mean pulmonary artery pressure from sea level to 14,110 ft, pulmonary arterioles did not show medial hypertrophy. It is concluded that the dog does not develop cardiac hypertrophy under these conditions of altitude exposure. Dogs were found to have a proportionately larger right ventricle than do most mammalian species. Author (TAB)

N70-20949# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHOTOSYNTHESIZING SYSTEMS OF HIGH PRODUCTIVITY [COLLECTION OF ARTICLES]

A. I. Budagovskiy et al Mar. 1968 330 p refs Transl. into ENGLISH of the book "Fotosinteziruyushchie Sistemy Vysokoi Produktivnosti" Moscow, Nauka, 1966 p 1-244

(AD-675382; FTD-MT-24-181-67) Avail: CFSTI CSCL 6/3

Contents: Problems of works on the study of photosynthetic activity of plants as a factor of productivity; the bases of the quantitative theory of the photosynthetic activity of snowings; the role of solar radiation in the photosynthetic activity of crops; photosynthetically active radiation on the territory of the USSR; biometric characteristics and dynamics of the development of a crop of corn; vertical distribution of biomass in sowings; spatial orientation of leaves in sowings and methods of its determination; an approximation method of determining the weakening and reflection of par and near infrared radiation in a sowing of corn by measurements of the integral radiation; light curves of photosynthesis in a sowing of corn; the determination of the vertical carbon dioxide profile in sowings; the use of the products of photosynthesis in the growth processes; concerning the increase of the coefficient of economic productivity of photosynthesis. TAB

N70-21005# Army Foreign Science and Technology Center, Washington, D.C.

MICROORGANISMS IN ROCK WEATHERING

A. N. Ilyaletdinov 5 Nov. 1969 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 34, no. 3, 1969 p 420-427

(AD-697528; FSTC-HT-23-075-70) Avail: CFSTI CSCL 8/7

The paper reviews literary materials on the participation of microorganism in the destruction of rocks and minerals. A study of rocks involves heterotropic microflora feeding at the expense of organic matter contained in algae and lichens. Organic acids formed as a result of oxidation of organic compounds by microorganisms are noted. TAB

N70-21018# Oak Ridge Associated Universities, Tenn. Medical Div.

[BIOLOGY AND MEDICINE] Research Report, Period Ending 31 Dec. 1968

1968 327 p refs

(ORAU-107) Avail: CFSTI

Research in cytogenetics, experimental radiotherapy, hematology, immunology, pathology, and ultrastructural anatomy during 1968 concerning the elucidation of mechanisms of radiation injury and its treatment is described. NSA

N70-21047# Akademiya Nauk URSR, Kiev.

THE SELECTION OF PROSPECTIVE CARRIERS OF BIOMETEOROLOGICAL INFORMATION

K. S. Voychishin, V. N. Mikhaylovskiy, Yu. Yu. Sikachevskiy, and V. N. Zhegar *In its* The Selection and Transmission of Inform., no. 17 1968 p 175-183 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Methods and some results of experimental verification are presented for a hypothesis on the correlation between the variations in magnetic field intensity and selected indices of bioactivity and meteorological processes. It is shown that variations in the vertical component of magnetic field intensity in the 2 to 32 hertz range do not correlate to a change in weather conditions or to the motor activity of certain living organisms. Transl. by H.W.

N70-21083 National Lending Library for Science and Technology, Boston Spa (England).

CONTROLLING LIGHT CONDITIONS BY MEANS OF POLYMER FILMS WITH SPECIFIC OPTICAL PROPERTIES [REGULIROVANIE SVETOVYKH USLOVII PRI POMOSHCHI POLIMERNYKH PLENOK S ZADANNYMI OPTICHESKIMI SVOISTVAMI]

G. I. Kosobokov, E. A. Chernetsova, T. I. Vyatleva, and S. A. Stanko [1963] 9 p refs Transl. into ENGLISH from Vestn. Sel'skokhoz. Nauki, (Moscow), v. 7, 1968 p 11-15

(NLL-RTS-5440) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Polymer films with different melt indices were tested for application in controlling solar radiation and heat energy effects on agricultural crops. Plants grown under polyethylene films show greater yields than those grown under polyamide films. R.S.

N70-21088 National Lending Library for Science and Technology, Boston Spa (England).

EFFECT OF ATMOSPHERIC HUMIDITY AND DURATION OF FERMENTATION ON THE COURSE OF OXIDATIVE PROCESSES [VLIYANIE VLAZHNOSTI VOZDUKHA I PRODOLZHITELNOSTI FERMENTATSII NA KHOD OKISLITELNYKH PROTSESSOV]

N. D. Tedeshvili Nov. 1969 8 p refs Transl. into ENGLISH from Biokhim. Chain. Proizv. Akad. Nauk SSSR, Inst. Biokhim. Sb. (Moscow), no. 8, 1960 p 103-108

(NLL-RTS-5471) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupon

The influence of atmospheric humidity on the enzymic oxidation of the withered tea leaf was investigated. Tea tips, withered at room temperature for 18 hours, were thoroughly ground in a mortar. The resulting mass was investigated gasometrically in a Warburg apparatus. The absorption of oxygen and excretion of CO2 were determined in parallel samples in the presence and absence of water at different atmospheric humidities: in one case the air was saturated with water vapour and the relative humidity of the air was 100%, while in the other case the relative humidity of the

air was that normal for the room. It was concluded from an examination of the curves that atmospheric humidity has no significant effect on the absorption of oxygen by pulverized withered leaf, for the character of the oxygen absorption curves is the same for different relative humidities of the air. Author

N70-21090 National Lending Library for Science and Technology, Boston Spa (England).
THE ROLE OF PINOCYTOSIS IN THE TRANSPORT PROCESS OF AMNIOTIC FLUID [ROL PINOTSITOZA IV PROTSESSE TRANSPORTA OKOLOPLODNYKH VOD]
E. K. Bakhtin Nov. 1969 8 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR. Biol.-Med. Nauk (Novosibirsk), v. 1, no. 5, 1967 p 61–65
(NLL-RTS-5461) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupon

To elucidate the individual stages of formation of pinocytosis invaginations as well as the nature of the forming vacuoles, an investigation of ultrastructural organization of the epithelium of the amniotic membrane was conducted. Both normal conditions and conditions following the administration into the amniotic space of ferritin whose structure and density make it detectable in the cell and on its surface were studied. The amnion of a white rat on the 16th to the 20th day of pregnancy was used as a model. The process of pinocytosis in epithelial cells of the amniotic membrane of the white rat serves not only for transferring substances into a cell but also for a systematic removal of functionally nonactive regions of plasma membrane from the cell surface. Perhaps this feature is typical not only for epithelial cells of the amniotic membrane but may be widespread among other pinocytotic cells. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-19783 Dunlap and Associates, Inc., Darien, Conn.
OPERATIONAL MEASURES OF PILOT PERFORMANCE DURING FINAL APPROACH TO CARRIER LANDING
Clyde A. Brictson *In* AGARD Meas. of Aircrew Performance Dec. 1969 13 p refs Submitted for publication (See N70-19779 08-04)
(Contract Nonr-4984(00))
Avail: CFSTI

Measures of pilot performance during night carrier landings were found to differ statistically and practically from daytime performance in terms of altitude control. Night approaches were characterized by more altitude variability, a larger percentage of approaches below glide slope and higher bolter rates compared with day approaches flown by the same pilots. Practical application of the performance data is discussed in terms of pilot and LSO training, visual landing aids and aviation safety. Empirical landing performance criteria are developed from the data and used to predict the probability of landing success as a function of deviations in final approach performance. Author

N70-19784# Boeing Co., Seattle, Wash. Military Airplane Systems Div.
AIRCREW TASK LOADING IN THE BOEING MULTIMISSION SIMULATOR
L. P. Zaitzeff *In* AGARD Meas. of Aircrew Performance Dec. 1969 5 p (See N70-19779 08-04)
Avail: CFSTI

The new multimission simulator, combining a 160 deg "real-world" visual display in high-resolution color, together with a completely functional and correlated cockpit, is described. The simulator permits aircrews to train in proposed aircraft and avionics systems and fly real-time missions over specially designated areas. The simulator was designed to evaluate aircrew performance using state-of-the-art concepts, controls, and displays incorporated in the cockpit of an advanced fighter/attack aircraft. Visual target acquisition performance was used as a measure of task loading in tests of one- and two-man crews flying both realistically task-loaded missions and sequences requiring visual target acquisition only. Visual target acquisition performance of two-man crews was significantly better than that of one-man crews in both types of flights. Author

N70-19786# Boeing Co., Seattle, Wash. Military Airplane Systems Div.
FLIGHT DECK WORK LOAD AND NIGHT VISUAL APPROACH PERFORMANCE
Conrad L. Kraft and Charles L. Elworth *In* AGARD Meas. of Aircrew Performance Dec. 1969 15 p refs (See N70-19779 08-04)
Avail: CFSTI

Research with a night visual approach simulator has provided data supporting a logical explanation for about 16 percent of air transport accidents. The explanation is in the form of a two-part hypothesis: a descent path that nulls out some visual information and a delay in relative motion supplement of the same information. The missing topographic information allows incorrect interpretation of altitude and distance. Most operational examples of this class of accidents include information about crew distractions, critical intrusions and work loads. In recent investigations, the flight deck work loads were altered by varying the frequency of appearance of other traffic which the pilot was instructed to detect and report to ground control. Analysis of the effect of work load on performance revealed this to be a significant factor only as it interacted with terrain slope and pilot differences, but not otherwise. Author

N70-19969# Radio Corp. of America, Moorestown, N.J. Defense Electronic Products.
TECHNOLOGY FOR THE TACTICAL ENVIRONMENT
David Shore *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 1-6 (See N70-19969 08-07)
Avail: CFSTI

Developed is the operational environment and a systems concept for the construction of a new mobile tactical air command and control model. The system encompasses a command center and a series of decentralized control centers of high mobility that are connected by automatic data processing and may even incorporate airborne technologies. A secure, automatically switched, trunk communications system will interconnect all elements. G.G.

N70-19988# Informatics, Inc., Bethesda, Md.
SIMULATING A TACTICAL IMAGE INTERPRETATION FACILITY IN THE LABORATORY
John J. Evans *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 267-290 (See N70-19968 08-07)
Avail: CFSTI

Factors which most influence the photo-interpreter's behavior and performance are studied with a laboratory simulation of an advanced tactical image interpretation system. This computerized system was designed to provide: (1) rapid retrieval of needed references; (2) specifications for optimal team communications and operating methods; and (3) procedures for controlling system operations and interpreter decision processes. This paper briefly describes pertinent operational imagery interpretation processes and problems. Major milestones in the design, development and implementation of a system simulation are then summarized. Particular attention is given to the balanced sharing of systems work between the man and the machine such that he is assisted and he is guided, but he is not driven by the automated subsystem in performing his work. Finally, important compromises in the design and test experiences are discussed. Author

N70-19989# Litton Systems, Inc., Van Nuys, Calif. Data Systems Div.
ADVANCED SYSTEM EFFECTIVENESS TECHNIQUES
Robert M. Stuckelman *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 291-298 refs (See N70-19968 08-07)
Avail: CFSTI

This paper describes advanced techniques for defining and evaluating the effectiveness of command and control systems. The techniques to be described are applicable to most command/control/information processing systems. The system effectiveness technique described herein is such an approach. Using it, a system is modeled with flow charts and performance is evaluated (via computer) based upon thousands of design parameters included in the model, using multiple input messages and various combinations of mission loading. Hardware, computer programs, communications, reliability, maintainability, personnel and logistic support factors are all taken into account in composite in predicting the system's performance in terms of reaction time for the various missions. Design decision impacts are evaluated by ascertaining the effects of differing parameters on the overall composite measure of performance. Confidence levels in composite system performance improve as the design progresses and as more test data becomes available to validate analytically determined parameters. Author

N70-20011# North American Rockwell Corp., Columbus, Ohio.
SYMPOSIUM ON APPLIED MODELS OF MAN-MACHINE SYSTEMS PERFORMANCE, COLUMBUS, OHIO, 12-14 NOVEMBER 1968 Final Report
Girard W. Levy 3 Nov. 1969 356 p refs
(Contract N00014-68-C-0418)
(AD-697939; NR69H-591) Avail: CFSTI CSCL 5/8

Contents: The role of applied man-machine models; The development of sophisticated models of man-machine system performance; Criteria for selection and application of models; A visual target acquisition model; Unfinished business in the utility of visual detection models; Modeling the sonar operators detection process--a progress report; Field evaluation of a visual detection model; Human operator models for manual control; Exposition of a human control model and its application; Computer simulation--savior, sanctuary, or silliness; Assumptions underlying the human reliability model; Application of a multiple task interactive model--simulation of human performance in sonar maintenance. TAB

N70-20368*# TRW, Inc., Cleveland, Ohio. Mechanical Products Div.
AIRCREW OXYGEN SYSTEM DEVELOPMENT Flight Test Report
R. J. Kiraly and A. D. Babinsky Dec. 1969 53 p
(Contract NAS2-4444)
(NASA-CR-73392; TRW-ER-7256-15) Avail: CFSTI CSCL 06K

Flight testing of the breadboard version of an aircrew oxygen system was conducted along with a breathing simulator to produce respiration flow rates and oxygen consumption and carbon dioxide removal addition at metabolic rates, a resources adapter to provide coolant and compressed air services, an instrumentation package to provide visual readouts of the system and component operating parameters, and a tape recorder which provided important data. Each test phase included four types of system operation: baseline performance, variation of breathing volumes, variation of breathing rates, and off design operation. Results indicate no significant change in the performance of the system. Author

N70-20428*# Space Sciences, Inc., Waltham, Mass.
NON-INVASIVE, MULTICHROMATIC EYE OXIMETER Final Report
Ronald A. Laing, Lee A. Danisch, and Laurence R. Young Oct. 1969 80 p refs
(Contract NAS12-2018)
(NASA-CR-86328) Avail: CFSTI CSCL 06B

The Eye Oximeter as an electro-optical instrument that noninvasively measures the oxygen saturation of choroidal blood in the back of the eye is described. The spectrophotometric method used by the Eye Oximeter is similar to that used in standard cuvette reflection oximeters such as the American Optical. The instrument consists of two basic systems: the Optical System and the Electronic System. The Optical System produces a suitable multi-chromatic beam of light, reflects this beam from the fundus of the subject's eye, and onto a low-noise photodetector. The Electronic System amplifies the weak composite signal from the photodetector, separates the two spectral components, computes the average oxygen saturation from the area of the fundus that was sampled, and displays the value of the computed oxygen saturation on a panel meter. The instrument is used with an external chart recorder to continuously record kinetic changes of either the oxygen saturation or the funds reflectivity at each of the two measuring wavelengths. Since choroidal blood is characteristic of blood which is supplied to the brain, the Eye Oximeter is essentially using the eye as a window to look into the brain. The instrument can be used to monitor the amount of oxygen which is supplied to the brain under varying external conditions. Author

N70-20433*# Stanford Univ., Calif. Dept. of Applied Mechanics.
ALTERATION OF THE STATE OF MOTION OF A HUMAN BEING IN FREE FALL
M. P. Scher and T. R. Kane Jul. 1969 199 p refs
(Grant NGR-05-020-209)
(NASA-CR-108938; SU-TR-198) Avail: CFSTI CSCL 06B

A weightless astronaut can employ certain movements of his limbs to alter either the orientation or the attitude motion of his body. To study such limb maneuvers, principles of rigid body dynamics are applied to models of the human body. Maneuvers producing pitch, yaw, and roll reorientations are described, and their effectiveness in changing the orientation of a man initially at rest as regards rotational motion is explored. The results of these analyses justify considerable optimism regarding the use of limb movements as a self-rotation technique. When the human possesses initial rotational motion, it is theoretically possible to perform maneuvers which convert the motion to a more desirable form. The underlying rationale involves relationships between kinetic energy and the nature of the motion. Analysis shows that the maneuvers in question must be performed with such precision that it is exceedingly difficult to control tumbling motions by means of limb movements. However, the methods developed can be applied successfully to control motions of certain artificial satellites. Author

N70-20434*# Stanford Univ., Calif. Dept. of Applied Mechanics.
PLANAR MOTION OF A HUMAN BEING UNDER THE ACTION OF A BODY-FIXED THRUST
J. D. Yatteau and T. R. Kane Sep. 1969 43 p refs
(Grant NGR-05-020-209)
(NASA-CR-108941; SU-TR-199) Avail: CFSTI CSCL 06B

Equations of motion are derived for a system comprised of two rigid bodies subjected to the action of a force of constant magnitude, the force being applied to one of the bodies along a line fixed in the body. Analytical and numerical solutions of these equations are then used to study effects of certain relative motions of the two parts of the system on the translation of the mass center and on the rotations of the bodies. The purpose is to assess the feasibility of providing a weightless astronaut with an extremely simple maneuvering device, namely, a single thruster, rigidly attached to one part of the astronaut's body, directional and attitude control to be achieved by means of limb movements. The results obtained are encouraging: Rectilinear motions of the mass center, accompanied by negligible rotational motions of the parts of the system, turn out to be possible if the subject is capable of performing in accordance with a simple linear feed-back law. Furthermore, it is found that substantial benefits can be derived even from open loop performance of certain maneuvers. Author

N70-20454# Army Foreign Science and Technology Center, Washington, D.C.
CYBERNETICS IN THE SERVICE OF COMMUNISM [KIBERNETIKU NA SLUZHBU KOMMUNIZMU SBORNIK STATEI]
A. I. Berg ed. 17 Sep. 1969 497 p refs Transl. into ENGLISH from Energiya (Moscow), v. 5, 1967 p 1-420
(AD-695085; FSTC-HT-23-145-69) Avail: CFSTI CSCL 6/4

The most important theoretical directions of cybernetics include: mathematical problems of cybernetics, including the branches of mathematics used in scientific research in the various trends of cybernetics; information theory; technical cybernetics, which studies control processes in technical systems; theory of reliability of control systems and their elements, which studies methods of analyzing reliability and ways of increasing it. In the applied directions, the most serious research is presently being carried out in the following areas: economics; chemistry; power engineering; transport; nature; psychology; and law. Author (TAB)

N70-20504# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AVIATION AND SPACE MEDICINE: SELECTED ARTICLES [AVIATSIONNAYA I KOSMICHESKAYA MEDITSINA]
P. V. Buyanov et al. 1 May 1969 7 p Transl. into ENGLISH from Aviats. i Kosmich. Med. (Russian), 1967 5 p
(AD-695909; FTD-MT-24-134-69) Avail: CFSTI CSCL 6/9

Results are summarized from two investigations on changes of cardiac electropotentials for flight personnel following flights which caused profound nervous-emotional tensions and on methods for the early exposure of pathology of the cardiovascular system. Results of hemodynamic studies are presented for the latter case. Conclusions are: (1) Psycho-emotional tension, connected with flight activity, causes a specific change in the functional condition of the cardiac muscle; (2) Recording of the EKG along with other methods, can be a test which helps the flight surgeon to correctly appraise psycho-emotional tension in connection with flight activity. Author (TAB)

N70-20509*# Texas Christian Univ., Fort Worth.
MAGNITUDE ESTIMATION: THE EXPONENT AND RANGE OF RESPONSE
Robert P. Markley Nov. 1969 9 p refs
(Grant NGR-44-009-01B)
(NASA-CR-108925) Avail: CFSTI CSCL 05J

Twenty-four subjects made magnitude estimation judgments of the apparent distance of a space vehicle in a reduced cue setting. The effects of stimulus range on response range and the exponent of a Stevens type power function were investigated. Limitations upon the generality of previous findings about the effects of this variable were discussed. Author

N70-20578*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROBABILITY LEARNING: FIRST-ORDER MARKOV STRUCTURES OF QUARTERNARY EVENTS
Edward M. Huff Washington Feb. 1970 14 p refs
(NASA-TN-D-5684) Avail: CFSTI CSCL 05J

Fifteen groups of subjects were exposed to different sequentially dependent stimulus sequences in a four-alternative probability learning paradigm. Groups were found to differ in both learning rate and terminal response levels as a joint function of the stochastic structure and the degree of dependence in the stimulus sequence. Events with common structural properties in different sequences were learned in a similar fashion. The manner in which subjects learn to predict four-alternative event sequences generated by first-order Markov processes is reported. Author

N70-20578*# Battelle Memorial Inst., Columbus, Ohio.
STUDY OF A WATER-VAPOR ELECTROLYSIS UNIT
J. E. Clifford, B. C. Kim, and E. S. Kolic Washington NASA Mar. 1970 63 p refs
(Contract NAS2-2156)
(NASA-CR-1531) Avail: CFSTI CSCL 06K

Continuing development of the acid-type water-vapor electrolysis concept for oxygen generation was directed toward interface factors for subsystem integration in advanced life support systems. The experimental program involved detailed analysis of product gas purity. The sulfuric acid type water-vapor electrolysis module had already completed 100 days of satisfactory operation at design conditions. During an additional 45 days of evaluation on this program, it was established that the small generation rate of ozone and acid spray could be controlled to well below the acceptable limits for continuous exposure by use of the usual charcoal and particulate filters used for trace-contaminant control. No other trace contaminants of concern were found in the oxygen (air) or hydrogen at a level of detection of 0.01 ppm. There was preliminary evidence that airborne bacteria were rapidly destroyed. Supplemental data on current/voltage relationships for individual cells of the module was obtained. Author

N70-20602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW PHYSIOLOGICAL SOCIETY. AVIATION AND SPACE MEDICINE SECTION. TRANSACTIONS (SELECTED ARTICLES)
9 Jul. 1969 13 p Transl. into ENGLISH from Moskov. Fiziol. Obshchestvo Sektsiya Aviats. i Kosmich. Med., (USSR), no. 1, 1967 p 128-133, 152-156
(AD-695942; FTD-MT-24-138-69) Avail: CFSTI CSCL 6/19

Contents: The problem of diurnal rhythm of physiological functions in man under conditions of insulation; Investigation of motor activity in man under conditions of hypodynamia and increased content of CO2. TAB

N70-20635# Kansas State Univ., Manhattan. Inst. for Environmental Research.
PROCEEDINGS OF THE SYMPOSIUM ON INDIVIDUAL COOLING
Ralph G. Nevins Jul. 1969 355 p refs Symp. held 17-18 Mar. 1969
(Contract F44620-68-C-0020)
(AD-694130; AFOSR-69-2397TR) Avail: CFSTI CSCL 6/17

The report contains twelve papers presented at a symposium on individual cooling. Author (TAB)

N70-20656*# Honeywell, Inc., Lexington, Mass. Radiation Center.
THE OCULOMETER Summary Report
John Merchant Oct. 1969 41 p refs
(Contract NAS12-531)
(NASA-CR-86331) Avail: CFSTI CSCL 06B

A description of an electro-optic system that tracks eye detail and computes eye direction several feet from the subject is summarized. The construction of a breadboard configuration of the oculometer for aircraft use is described. J.M.C.

N70-20683*# AiResearch Mfg. Co., Los Angeles, Calif.
THE INTRAVEHICULAR ACTIVITY SPACE SUIT Final Report, 5 Aug. 1968 – 1 Feb. 1970
D. Friedman 13 Feb. 1970 51 p refs
(Contract NAS9-7555)
(NASA-CR-108278; Rept-70-6053) Avail: CFSTI CSCL 06K

The pertinent results of testing performed on prototype suits are presented, in addition to; (1) a description of the design of the IVA suit assembly; (2) fabrication techniques and problems encountered, and (3) recommendations for future development of the IVA suit concept. A summary presents highlights and the important aspects of the program. Author

N70-20717*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SYSTEM FOR COMMUNICATING BIOMEDICAL

INFORMATION BY MEANS OF UNMODIFIED CONVENTIONAL VOICE COMMUNICATION SYSTEMS Patent Application
Charles E. Lewis, Jr., Lewis R. Carpenter, and Robert T. McDonald, inventors (to NASA) Filed 30 Jun. 1969 31 p
(Contract NAS4-1133)
(NASA-Case-FRC-10031; US-Patent-Appl-SN-856511) Avail: CFSTI CSCL 09F

A communication system for transmitting biomedical information obtained from a patient in a moving ambulance to a hospital for diagnosis. In the ambulance the information is converted into a frequency modulated (FM) audible signal which is then air coupled to the microphone of the two-way radio communication system in the ambulance, producing an FM/FM VHF signal. This signal is received at the ambulance's dispatch center where the first demodulation is accomplished removing the VHF carrier. Thereafter, the demodulated signal in the form of a frequency modulated audible signal is air coupled to the microphone of a telephone for transmitting these signals via a telephone link to the hospital. At the hospital the audible signal is again demodulated to extract the biomedical information which it contains. NASA

N70-20738*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METABOLISM MONITOR FOR SPACE ACTIVITY Patent Application
John R. Rasquin, inventor (to NASA) Filed 4 Nov. 1969 16 p
(NASA-Case-MFS-20092; US-Patent-Appl-SN-873792) Avail: CFSTI CSCL 06B

A system for monitoring the metabolic rate of an astronaut having a CO2 analyzer used in conjunction with a spacesuit and life support system that provides an oxygen atmosphere to the interior of the spacesuit. The analyzer includes a sampling chamber through which the exhaust from the spacesuit is passed, a source of infrared radiation, a filter that passes only IR radiation having a wavelength of about 4.4 microns, an IR detector, and a signal processing apparatus for amplifying and reading out the signal from the IR detector. A wavelength of 4.4 microns is necessary because at this wavelength IR passed through the sampling chamber will be absorbed by CO2, but not by water vapor in the spacesuit exhaust. NASA

N70-20813# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW
Wade B. Holland Jul. 1969 123 p refs *Its* Ser. Vol. 3, No. 7
(Contract F44620-67-C-0045)
(AD-694051; RM-6000/7-PR) Avail: CFSTI CSCL 9/2

The special issue is devoted to programming and programming languages. A revolution comparable to the FORTRAN II era in U. S. computing has been taking place in Soviet software, particularly in the development of algorithmic languages and translators. While ALGOL remains the basis of Soviet programming languages, interest is growing in FORTRAN, COBOL, and SIMSCRIPT, and local languages have been developed. New directions in Soviet computing are evidenced by trends toward large machines and third-generation (ASVT) computers that are compatible with the IBM Series/360; integration of hardware and system design; and new concern with man-machine interaction. Manifesting this heightened interest, the First All-Union Conference on Programming was held in November 1968. The issue contains abstracts of the papers presented and a full translation of a report on the use of automata theory in resolving problems in the man-machine interface. Author (TAB)

N70-20855*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
MOTIVATION: A SELECTED BIBLIOGRAPHY
20 Feb. 1970 62 p refs
(NASA-TM-X-64072; GP-816) Avail: CFSTI CSCL 05J

A bibliography of publications on motivation is presented. Books on the subject are listed regardless of publication date, but only articles published after 1960 are included. The bibliography is arranged by title, with subject-author index. Author

N70-20886# California Univ., San Diego. La Jolla Dept. of the Aerospace and Mechanical Engineering.
OPTIMIZATION OF A STANDARD LINEAR VISCOELASTIC MATERIAL FOR USE IN A SEAT BELT Technical Report
W. Nachbar and J. B. Schipmoelder Nov. 1969 19 p refs
(Contract N00014-69-A-0200-6007)
(AD-697677; TR-1)

It is shown that a properly designed viscoelastic seat-belt material could have a low stiffness at low strain rates while still affording considerable improvement in the maximum safe cruising speed in comparison with a linear elastic belt. Author (TAB)

N70-20914# Tokyo Univ. (Japan). Inst. for Nuclear Study.
ON THE LOGICAL AND CONCEPTUAL FOUNDATIONS OF RADIATION DOSIMETRY
Kazuaki Katoh Jun. 1969 16 p refs
(SJC-A-69-2) Avail: CFSTI

The currently used system of radiation dosimetry that is based on the recommendations made by ICRU and ICRP are criticized from the view point of logical consistency. Proposals are made to construct a better system. Author (NSA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-19714*# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.
MEASUREMENT OF ADSORPTION STAY-TIMES OF SEVERAL ATMOSPHERIC GASES ON STAINLESS STEEL
W. F. Bailey, Jr. (M.S. Thesis) Jun. 1969 85 p refs
(Grants NGR-47-005-046; NsG-682)
(NASA-CR-108232; AEEP-4038-111-69U) Avail: CFSTI CSCL 07D

A simple time-of-flight method is used to determine mean times of adsorption of gaseous molecules on a solid surface. A room temperature aerodynamic molecular beam is pulsed by a slotted chopper disk, impinges on a stainless steel target, and a portion of the reemitted molecules passes through a density sensitive time-of-flight detector. The response of the detector is compared for diffuse emission of beam molecules from the test surface with zero stay time and with a distribution of stay time. The mean stay time is inferred from the shift in the maxima of the detector response for both stay times. Author

N70-19721 Purdue Univ., Lafayette, Ind.
THE SPECIFIC HEAT AND PARAMAGNETIC SUSCEPTIBILITY OF STOICHIOMETRIC AND REDUCED RUTILE (TiO_2) FROM 0.3 TO 20 K
Thomas Robert Sandin (Ph.D. Thesis) 1968 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-7495

The specific heat of rutile (TiO_2) was measured between 0.3 and 20 K in different magnetic fields, and for various degrees and types of reduction. The paramagnetic susceptibility was measured below 4.2 K for three reduced samples. The parameters which characterize the specific heat of the stoichiometric boule include a Debye theta at T=0 of 778 K, an optical model of Einstein frequency 83 cm/1, and an impurity of 1.08 ppm Fe(3+). The specific heat of all reduced samples indicates that there is a narrow intrinsic conduction band lying below the wider conduction band

seen above 30 K. The electrons in this band have a density of states effective mass of 190 m sub e. Small polaron theory may account for the narrowness of the band. In the more highly reduced samples, the defects are not impurity related. Dissert. Abstr.

N70-19735# Oak Ridge National Lab., Tenn.
STUDY ON REMOVAL OF IODINE FROM ATMOSPHERE BY SPRAY. PART 4: REMOVAL OF IODINE BY REACTIVE SPRAYS
Yukinori Nishizawa et al 1969 15 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi, (Tokyo), v. 11, 1969 p 340-346
(ORNL-TR-2241) Avail: CFSTI

The results of measurements are analyzed for spray washout rates under varying solution temperature and concentration conditions when a solution which reacts with iodine is used as the spray. Materials tested as sprays include: NaOH; Na2S2O3; and Na2SO3 solutions. Test temperatures ranged from room temperature to 150 C. The spray runs between room temperature and 80 C were carried out by the steady state spray process in which both the spray water and container temperatures were held constant. The runs at 100 to 150 C were designed to simulate actual incident conditions by following the cooling spray method in which cold spray is injected into a saturated steam atmosphere. Author (NSA)

N70-19738# Scientific Translation Service, Ann Arbor, Mich.
CALCULATION OF THE KINETICS OF AMMONIA RADIOLYSIS IN THE GAS PHASE. PART 2: HYDRAZINE YIELD AS A FUNCTION OF TEMPERATURE AND PRESSURE [RASCHET KINETIKI RADIOLIZA AMMIAKA V GAZOVOI FAZE. 2: ZAVISIMOST' VYKHODA GIDRAZINA OT TEMPERATURY I DAVLENIYA]
B. G. Dzantiev et al [1969] 14 p refs Transl. into ENGLISH from All-Union Inst. of Sci. and Tech. Inform. (USSR), 1969 Sponsored by AEC Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-785) Avail: CFSTI

The temperature dependence of the nonstationary and stationary hydrazine yield was calculated for the radiolysis of gaseous ammonia in the temperature range T = 300 to 600 K for various dose rates by numerical integration of the chemical rate equations under the assumption of a determining role of H and NH2 radicals in the mechanism. The influence of pressure on the rate of ammonia decomposition and on the rate of molecular hydrogen formation was studied. An analysis of the relations obtained indicated the existence of three temperature ranges in which the mechanism of hydrazine formation is determined by different elementary processes. The conditions of transition from one range to another depend on the activation energies of the corresponding processes and on the dose rate. A comparison of the calculated data with the experimental ones demonstrated the suitability of the model discussed for describing the temperature dependence of the hydrazine yield. The influence of pressure on this process was considered as a function of the instantaneous contact time, dose rate, and temperature. Author (NSA)

N70-19745# Michigan State Univ., East Lansing. Chemistry Dept.
AN INVESTIGATION OF SOME LANTHANIDE BORON, CARBON, NITROGEN, SILICON, CHALCOGENIDE, AND HALIDE SYSTEMS AT ELEVATED TEMPERATURES
Technical Progress Report, 1 Feb. 1969-31 Jan. 1970
Harry A. Eick [1970] 32 p refs
(Contract AT(11-1)-716)
(COO-716-051) Avail: CFSTI

Progress is reported on studies of the vaporization behavior of TmC2; the crystal structure of TmC2; vaporization behavior and crystal structure of YbCl2, and other features of the Yb-Cl system; thermal decomposition of SmOF; vaporization of EuS; vaporization thermodynamics of EuBr2; and the structure of YbOCl. NSA

N70-19754# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
STANDARD REFERENCE MATERIALS: BORIC ACID: ISOTOPIC, AND ASSAY STANDARD REFERENCE MATERIALS
E. J. Catanzaro, C. E. Champion, E. L. Garner, G. Marinenko, K. M. Sappenfield et al Feb. 1970 72 p refs
(NBS-Spec-Publ-260-17) Avail: SOD $0.65 Catalog No. C 13.10:260-17

A precise coulometric titration method is described for the assay of boric acid. Multiple samples of boric acid are studied and characterized with respect to homogeneity and the effect of relative humidity on stoichiometry. Procedures for precise preparation, aliquoting, and storage of boric acid solutions are devised. A mass spectrometric technique for the precise measurement of boron isotope ratios is developed. The effects of various parameters such as sample mounting procedure, filament material, sample size, total sample composition, and sodium concentration are studied and alternative procedures are evaluated. Author

N70-19756 North Carolina State Univ., Raleigh.
CALCULATION OF PROTON-PROTON SPIN-SPIN COUPLING CONSTANTS IN POLYCYCLIC AROMATIC HYDROCARBONS
Martin Aron Mainster (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-7678

A method for computing nuclear spin-spin coupling constants is modified by the explicit inclusion of the effects of the p-electron system and used to study the proton-proton coupling constants of polycyclic hydorcarbons. Calculated values for adjacent protons are reasonable and experimentally observed absence of significant inter-ring coupling is predicted, but neither the sign nor the magnitude of nonadjacent intra-ring couplings can be accurately determined by this technique. The p-electron spin-spin coupling constant for adjacent protons in polycyclic aromatic hydrocarbons is found to offer a more precise description of carbon-carbon bond lengths than bond order. This relationship is then used with a second relationship found to exist between bond order and sigma-electron contribution to the total coupling constant in order to explain why other authors were able to obtain a description of the total coupling constant in terms of a characterization of the pi-electron system only. Dissert. Abstr.

N70-19770 Virginia Polytechnic Inst., Blacksburg.
KINETICS OF PROPYLENE DISPROPORTIONATION OVER A COBALT OXIDE-MOLYBDENA-ALUMINA CATALYST
Michael Justin Lewis (Ph.D. Thesis) 1969 232 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.00 Order No. 69-5523

An investigation was undertaken to determine the rate controlling mechanism and to obtain a rate expression for propylene disproportionation over a cobalt oxide-molybdena-alumina catalyst. This system was studied by the method of differential rates. Both initial rates and rates at various conversion levels were measured at 150, 325, and 400 degrees Fahrenheit. For initial rates total pressure was varied and for conversion rates both total pressure and partial pressures were varied. The major pieces of experimental apparatus were a fixed bed catalytic reactor with the necessary flow and temperature control equipment and a gas chromatograph for product analysis. The reactor was constructed from 3/8 inch stainless steel tubing and enclosed in a two inch jacket through which heat transfer oil was pumped for temperature control. Flow rates and catalyst charges were used such that conversion was usually five to eight per cent for initial rate studies, and the increase in conversion was usually five to eight per cent for conversion rate studies. Dissert. Abstr.

N70-19776# United Kingdom Atomic Energy Authority, Harwell (England).

DETERMINATION OF PRASEODYMIUM IN ZIRCON BY ABSORPTIOMETRIC AND RADIOACTIVATION METHODS
G. S. Spicer Mar. 1969 9 p refs
(AERE-AM-109) Avail: CFSTI

In the absorptiometric method the zircon is decomposed by fusion with potassium hydrogen fluoride, praseodymium is separated as fluoride, which is then converted to the perchlorate, and the absorbancy is measured at 444 nm. In the alternative procedure the sample is subjected to neutron irradiation, decomposed as above, and the fluoride is converted to the oxalate for counting purposes after precipitation of the hydroxide. The methods can be applied to the analysis of zircons containing 1 to 10% praseodymium. Replicate determinations using the absorptiometric method gave a value of 2.25% for the praseodymium content of a zircon, and the coefficient of variation was 4.4%. Radioactivation gave a mean content of 2.23% with a coefficient of variation of 4.5%. Lanthanum was present as an impurity at the 0.06% level.
Author (NSA)

N70-19788 Texas Christian Univ., Fort Worth.
THE CRYSTAL STRUCTURES AND PROPERTIES OF COPPER(II) AND ZINC(II) COMPLEXES OF BETA-DIKETONES AND AROMATIC N-OXIDES
Ray Stuart Sager (Ph.D. Thesis) 1968 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-6606

This work describes a study of the structures and properties of copper(II) and zinc(II) complexes. Copper and zinc chloride complexes of pyridine N-oxide and its methyl derivatives were prepared and characterized. Elemental analysis, molecular weights, unit cell dimensions, space groups, densities, and thermal properties were determined for the complexes. Copper and zinc complexes of trifluoroacetylacetone, hexafluoroacetylacetone, and trifluorobenzoylacetone were also prepared and studied. Most of the beta-diketone complexes were isolated as hydrates, and one form of bis(trifluoroacetylacetonato) zinc(II) exists as a trimer.
Dissert. Abstr.

N70-19790# Carnegie-Mellon Univ., Pittsburgh, Pa.
THERMOCHEMICAL STUDIES IN AQUEOUS SOLUTIONS AND AQUEOUS MIXTURES. PART 1: HEATS AND ENTROPIES OF IONIZATION. PART 2: ELECTRODE POTENTIALS FROM THERMAL DATA. PART 3: THERMOCHEMICAL INVESTIGATIONS OF THE WATER-TRIETHYLAMINE SYSTEM
John W. Larson (Ph.D. Thesis) 1968 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-3942

The thermodynamics of ionization are examined in connection with linear free energy relations. Empirical relations between the thermodynamic properties of ionization lead to the proper form of the Hammett equation. Electrostatic theories of acid ionization are correlated with the empirical results. Partial molar heats of solution of both water and triethylamine have been measured at 15 deg over the whole range of composition in the water/triethylamine system. Integral heats of mixing have been calculated from these results and compared with earlier results obtained by different methods. Vapor pressure data have been used in calculating partial molar free energies, and have been combined with partial molar heats to yield partial molar entropies, which indicate that triethylamine is a structure maker in dilute aqueous solution. Heats of solution of several nonelectrolytes have also been measured in water/triethylamine systems. Results are discussed in relation to heats of solution in water/ethanol and the effects of third components on critical mixing in water/triethylamine systems.
Dissert. Abstr.

N70-19793# St. Johns Univ., Jamaica, N.Y.
PARTIAL VOLUMES OF THE WATER-METHANOL AND WATER-ETHANOL SYSTEMS AT 30 C
Donald William LaPalme (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-4128

A dilatometric method is described for the precise evaluation of the partial specific volumes of liquids over the entire range of composition. The method was used to determine the partial specific volumes of the water-methanol and water-ethanol systems at 30°C. Analytic expressions for water and alcohol are developed from a consideration of the specific volume of a binary system and a Gibbs–Duhem type equation. The single expressions are then evaluated from simultaneous treatment of the information using a Fortran 2 computer program. The partial specific volumes of the water and the alcohol can be expressed as a function of the preferred composition variable weight fraction.
Dissert. Abstr.

N70-19798 New Mexico State Univ., University Park.
THE THERMODYNAMICS OF THE INTERACTION OF XENON AND MYOGLOBIN
Sigfredo Maestas (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-6056

The interaction between xenon and myoglobin is investigated. Absorption data are obtained at various temperatures for metmyoglobin, myoglobin, and cyanometmyoglobin and xenon at pressures up to 4.85 atm. The values of the thermodynamic functions for the three interactions are derived. The binding forces are of the order of van der Waal attractions. The high entropy losses indicate that a specific site is occupied by the Xe atom on the myoglobin molecule. Metmyoglobin and myoglobin appear to interact with xenon in dual equilibrium processes. The second step of these interactions is extremely weak for xenon and myoglobin at the same temperature. Xenon solubilities in water at 20C, 25C, and 30C are studied. These follow Henry law in the pressure range 0–4.85 atm at the three temperatures. The Henry law constants are 202 atm/m at 20C, 227 atm/m at 25C, and 268 atm/m at 30C.
Dissert. Abstr.

N70-19799 Louisiana State Univ., Baton Rouge.
THERMODYNAMIC PROPERTIES AND ENERGY FUNCTIONS OF SOLUTIONS
Chung-ying Liu (Ph.D. Thesis) 1968 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-4486

A unique calorimeter based on the principle of thermography was developed. The calorimeter interior was free of unnecessary devices which cause heat effects not readily observed. It had a fifty-three junction thermopile which served as an extremely sensitive temperature detector. Heats of mixing were obtained for binary systems including ethanol-water, acetone-water, and ethanol-acetone at 30C, and methanol-water and methanol-benzene at various temperatures between 25 and 60C covering the entire concentration. The effect of temperature on activity coefficients was then calculated. The heats of mixing were combined with existing vapor pressure data to obtain partial molar quantities and the entropy changes upon mixing were calculated. A rigorous method was developed to obtain the absolute values of various energy functions of pure components.
Dissert. Abstr.

N70-19806*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
THERMODYNAMICS AND KINETICS OF HETEROGENEOUS REACTIONS
J. Clair Batty and Robert E. Stickney 2 Jun. 1969 68 p refs
(Grant NGR-22-009-091)
(NASA-CR-108254; TR-473) Avail: CFSTI CSCL 07B

A generalized treatment of heterogeneous chemical reactions is developed and applied to several sublimation, catalytic, and

oxidation processes. The approach is essentially a systematic reformulation of the quasi-equilibrium analyses of Langmuir, Richardson, and others, and it is generalized to apply also to conditions encountered in molecular-beam studies of gas-solid interactions. An advantage of the quasi-equilibrium approach is that it minimizes the use of kinetics to the degree that rate expressions are obtained without assuming detailed kinetic models of the processes. In Part I, we consider simple sublimation processes (vaporization, thermionic emission, and self-surface ionization) and catalytic reactions (surface ionization and molecular dissociation). The reaction of gaseous oxygen with solid tungsten, molybdenum, and graphite is treated in Part II for steady-state conditions, and this treatment is extended in Part III to the transient case of flash desorption of oxides from a tungsten surface. The theoretical results are compared with existing experimental data, and the agreement is surprisingly good in view of the simplicity of the approach. Author

N70-19809 University of Southern Calif., Los Angeles.
THE PHOTOCHEMISTRY OF VARIOUS CHROMIUM (III) COMPLEX IONS
Robert Derwood Lindholm (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9030

The purpose of this study was to investigate the photochemistry of several chromium (III) complexes in an effort to correlate their photochemical reactions with particular electronically excited ligand field states. The assignments between the ligand field absorption bands and the resulting electronically excited states are well understood for these complexes. In addition, the fact that chromium (III) complexes exhibit very slow thermal aquation rates and undergo only photosubstitutior type reactions make them very well suited for such studies. Two approaches were employed during the course of this investigation. The first involved the measurement of the extreme temperature dependence on the aquation quantum yields for two chromium (III) complexes in mixed solvent systems which were capable of forming glasses at low temperatures. The second approach involved the investigation of a chromium (III) complex, thiocyanatopentaamminechromium (III) ion, which was capable of exhibiting two modes of photoaquation. Dissert. Abstr.

N70-19810 City Univ. of New York.
EFFECT OF VIBRONIC COUPLING ON RATE OF SPREADING OF EXCITON WAVE PACKET-HIGHER ORDER EFFECTS
Elie Lowy (Ph.D. Thesis) 1969 233 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-7603

In a recent paper A. Bierman calculated a first correction to the rate of spreading of an exciton wave packet in an infinite one-dimensional crystal, paying attention to both the initial conditions and the effects of phonon-exciton coupling. The calculation was made assuming strong, nearest neighbor coupling and initial conditions in agreement with the Franck–Condon principle. The solution, carried through the second order perturbation showed a time dependent decrease of the rate of spreading. In this paper we pursue this calculation to fourth order, showing that the rate of spreading is now increased. Dissert. Abstr.

N70-19871*# Monsanto Research Corp., Dayton, Ohio.
THERMALLY RESISTANT POLYMERS FOR USE AS FUEL TANKS SEALANTS Annual Summary Report, 1 Jul. 1968–30 Jun. 1969
John Mann Butler, Clayton E. Hathaway, James A. Webster, and Richard P. Quill 10 Jul. 1969 74 p refs
(Contract NAS8-21401)
(NASA-CR-102444; ASR-1) Avail: CFSTI CSCL 07C

Siloxane and perfluoroalkylene-containing polymers were investigated as elastomeric fuel tank sealant materials. Isocyanato phenyl- and isocyanatophenoxy-capped polysiloxane intermediates were prepared and polymerized by cyclotrimerization to form poly-isocyanurate-linked polymers. Although the polymers having the phenoxy silicon bonding were hydrolytically unstable the phenylsilicon-bonded polymers were both hydrolytically and thermally stable. Isocyanatophenyl-capped perfluoroalkylene intermediates were prepared and polymerized by cyclotrimerization. The resulting isocyanurate polymer was thermally stable. Perfluoroalkylene diisocyanate intermediates were prepared but these compounds could not be polymerized readily to form isocyanurates. The feasibility of linking perfluoroalkylene chains through acetylene trimerization reactions was investigated with the model compound, perfluoropropyl ethynyl ketone. Author

N70-19884 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF DISPERSING MEDIUM pH ON THE AGGREGATION STABILITY OF AN AQUEOUS SUSPENSION OF TiO2 [VLIYANIE PH DISPERIONNOI SREDY NA AGREGATIVNUYU USTOICHIVOST GIDROSUSPENZII TiO2]
A. V. Samokhim et al Dec. 1969 4 p refs Transl. into ENGLISH from Tr. Mosk. Khim. Tekhnol. Inst. (Moscow), no. 58, 1968 p 219–221
(NLL-RTS-5539) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

Over a wide range of change in medium pH, it was determined that change in pH affects the zeta potential and aggregation stability of aqueous dispersions of titanium dioxide pigment. Adsorption capacity measurements of pigment particles were carried out using TiO2 freed from traces of electrolyte impurities. The various pHs were obtained by adding hydrochloric acid or sodium hydroxide. Aggregation stability was determined by measuring optical densities of centrifuged suspensions for the sols remaining after removing the precipitate. The particles are negatively charged at pH 3 to 11, and the zeta potential rises to 40 to 45 mV, but further increase in pH leads to a drop in zeta potential. Such change is connected with a sharp increase in electrical conductivity of the disperse medium and a corresponding decrease in the diffuse part of the double layer. Results show that the pH 7 divided by 10 state is best for securing stable aqueous dispersions of titanium dioxide with maximum zeta potential; at this level the electrical conductivity of the solution is relatively low. E.M.C.

N70-19899# California Univ., Los Angeles. Dept. of Chemistry.
ELECTROPHILIC SUBSTITUTION REACTIONS OF 1,6-C2B7H9
Gary B. Dunks and M. Frederick Hawthorne 20 Nov. 1969 36 p refs Submitted for publication
(Contract N00014-67-A-0111-0021)
(AD-698141; TR-11) Avail: CFSTI CSCL 7/3

Electrophilic substitution reactions of 1,6-dicarba-closo-nonaborane(9) were studied and found to occur preferentially at the boron atom in the 8 position. Methyl, ethyl, bromo and tetrabromo derivatives, were prepared and structurally characterized by H and 11B nmr spectroscopy. Author (TAB)

N70-19938# Office of Naval Research, London (England).
THE SHAPES OF SMALL MOLECULES, AN OXFORD INORGANIC DISCUSSION SPONSORED BY THE CHEMICAL SOCIETY, 26 SEPTEMBER 1969
Charles P. Smyth 31 Oct. 1969 7 p refs
(AD-698090; C-17-69) Avail: CFSTI CSCL 7/4

A one-day discussion of the shapes of small molecules was devoted, partly to structural theory, partly, to electron spin resonance, but, in greatest part, to the methods and results of

spectroscopy. Measured bond angles and lengths were reported in order to show the shapes and sizes of many small molecules and give information concerning the nature of the bonds. Author (TAB)

N70-19997 National Lending Library for Science and Technology, Boston Spa (England).
THE INDUSTRIAL ELECTROSYNTHESIS OF ORGANIC COMPOUNDS [PROMYSHLENNYI ELEKTROSINTEZ ORGANICHESKYKH SOEDINENII]
M. Ya. Fioshin et al Jan. 1970 40 p refs Transl. into ENGLISH from Usp. Elektrokhim. Organ. (USSR), 1966 p 256-277
(NLL-RTS-5500) Avail: Natl. Lending Library, Boston Spa, Engl.: 40s or 5 NLL photocopy coupons

Economic and technological advantages of electrochemical methods of synthesis are discussed. Cathode and anode electrosynthetic processes for organic compounds are examined. Examples using cathode processes include the electrosynthesis of adiponitrile, hexamethylenediamine and aminocapronitrile, salicylaldehyde, and glycerol. Anode processes examined include the electrosynthesis of teraethyl lead, melamine, and higher dicarboxylic acids. A method for electrochemical purification of waste waters is described. The method involves the addition of waste water, after filtration, to an electrolyzer without a diaphragm, which is fitted with steel cathodes and graphite anodes. Cost analysis shows that the electrochemical method is at least twice as cheap as the chemical method, for the decomposition of waste materials containing cyanide compounds, requires less complex equipment, and can be used for the purification of waste waters from various products. D.L.G.

N70-19999 National Lending Library for Science and Technology, Boston Spa (England).
COAGULATION OF FINELY DISPERSED PRECIPITATES OF METATITANIC ACID [KOAGULYATSIYA TONKODISPERSNYKH OSADKOV METATITANOVOI KISLOTY]
I. V. Gebler et al Dec. 1969 5 p refs Transl. into ENGLISH from Izv. Tomskogo Ordena Trudovogo Krasnogo Znameni Politekhn. Inst. im S. M. Kirova (USSR), no. 148, 1967 p 106-107
(NLL-RTS-5527) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 s or 1 NLL photocopy coupons

Humic acids are proposed as an alterantive to the use of expensive coagulants. It is shown that in hydrocloric acid solutions of titanium, the negatively charged particles of humic acid neutralize the positive charges of the particles of metatitanic acid, causing coagulation of the precipitate. A necessary condition for the use of humate coagulant is the maintenance of an acid medium of the solution before and after the addition of the humate. A method for the production of humate coagulant from peat is described. The ammonium humate coagulant obtained causes complete separation of the precipitate in the filtration of acid suspensions. D.L.G.

N70-20001# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
NEWEST ELEMENTS OF THE MENDELEEV PERIODIC TABLE. PERSPECTIVES AND CHEMICAL PROBLEMS OF THE SEARCH FOR SUPER-HEAVY ELEMENTS
G. N. Flerov 1969 27 p refs
(JINR-E15-4851) Avail: CFSTI

The state of investigations on the synthesis and properties of far-transuranium elements is considered. Perspectives and chemical problems in the search for super-heavy elements are analyzed. The possibilities of accelerators in this respect are considered. The possible existence of super-heavy elements in cosmic rays and minerals is discussed. Author (NSA)

N70-20012# Olin Mathieson Chemical Corp., New Haven, Conn.
IONIC FLUORINE CHEMISTRY Semiannual Status Report (Final), 1 May-31 Aug. 1969
Gene A. Hyde and Samuel I. Trotz 31 Oct. 1969 34 p refs
(Contract N00014-67-C-0435)
(AD-697970; SASR-5) Avail: CFSTI CSCL 7/2

The report describes attempts to prepare iodine-fluorine interhalogen salts wherein both ions contain iodine and fluorine, or iodine, fluorine, and/or oxygen. Three starting materials were successfully prepared, CsIF6, IF4SbF6, and IF6SbF6, whose metathetical interactions would have given desired interhalogen salts. Failure to find suitable solvents for the intended reactions was primarily responsible for a lack of success in this area. In the course of preparing CsIF6 a previously unreported adduct was isolated, CsIF6.2IF5, and infrared and X-ray characteristics are given. One other positive aspect of the investigations is the partial clarification of the reactions of I2O5 with IF5 and IF7 as regards the synthesis of IO2F and IOF3. Author (TAB)

N70-20015# Army Foreign Science and Technology Center, Washington, D.C.
EFFECT OF THE METAL SUPPORT ON PHOTOLYSIS OF AN ADDUCT WITH URETHANE AND ISOCAYNATE GROUPS
N. P. Kurgan et al 7 Nov. 1969 13 p refs Transl. into ENGLISH from Kiev-Naukova Dumka USSR, no. 5, 1968 p 212-218
(AD-698171; FSTC-HT-23-414-69) Avail: CFSTI CSCL 7/5

The compound, 3-isocyanato-4-methyl carbanilic acid triester with 2-ethyl-2-(hydroxymethyl)-1-3-propanediol, was photolyzed to help clarify the effects of metals surfaces in the photolysis of polyurethanes. TAB

N70-20038 Stanford Univ., Calif.
CONFIGURATIONAL STUDIES ON REPRESENTATIVE POLYAMIDE, POLYESTER, AND POLYVINYL CHAINS
Alan David Williams (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8300

The rotational isomeric state model is applied to chains containing both symmetric and asymmetric centers. Configurational statistics of these chains are treated considering only short range intramolecular interactions, i.e., those involving rotations about individual bonds and consecutive bond pairs. Various conformational properties are calculated. These calculations illustrate how chains of varying molecular weight with complicated repeat units can be systematically treated on this basis. The results are in good agreement with available experimental data. A general method of calculating mean-square moments for chains where rotational states from different units are mutually independent has been derived. This method has been used to treat chains in which rigid amide and ester groups assure independence of rotational states of neighboring bonds. Dissert. Abstr.

N70-20049# Kentucky Research Foundation, Lexington.
HIGH TEMPERATURE REACTIONS OF SUBSTITUTED PYROLES Final Report, 1 Sep. 1965-30 Sep. 1969
John M. Patterson Sep. 1969 10 p refs
(Contract DA-ARO(D)-31-124-G675)
(AD-698043; AROD-5551.4-C) Avail: CFSTI CSCL 7/3

Research was undertaken to elucidate product formation and the reaction path followed in the thermally-induced isomerization of N-substituted pyrroles. Various parameters such as the effect of substituents (pyrrole-ring substituents and migrating-group substituents) on migration aptitudes, on product distribution and on reaction rate were investigated. The study of a reaction in which the potential migrating group is optically active was proposed in order to determine the nature of migration process. Author (TAB)

N70-20052# Monsanto Research Corp., Dayton, Ohio.
INFRARED SPECTRA OF INORGANIC COMPOUNDS IN THE 500-33/CM REGION Technical Report, Sep. 1968-Mar. 1969
William R. Feairheller, Jr. and John T. Miller, Jr. Oct. 1969 60 p refs
(Contract F33615-67-C-1363)
(AD-697992; AFML-TR-69-233) Avail: CFSTI CSCL 7/2

A literature review has been conducted on the infrared spectra of simple inorganic compounds in the 500-33/cm region, including most of the information available through mid-1968. This review has been limited to the simple anion and metal-anion vibrations and does not include the metal complexes. Some experimental work has been included to provide examples of some of the effects. The observed vibrations of the various inorganic compounds in the 500-33/cm region are tabulated.
Author (TAB)

N70-20062*# Institute for Research, Houston, Tex.
FEASIBILITY STUDY ON ANALYTICAL TECHNIQUES FOR DETECTION OF GLYCOL VAPOR Final Report
Benjamin Mosier 1 Aug. 1969 54 p
(Contract NAS9-7570)
(NASA-CR-102195) Avail: CFSTI CSCL 07B

A detailed discussion of the physical and chemical properties of ethylene glycol and the silica gel adsorbent is presented. The glycol is readily oxidized by periodic acid to formaldehyde. Formaldehyde may be specifically determined without any interferences by its reaction with a substituted catechol compound. The color development is enhanced by an acid precursor which is adsorbed into a specially purified grade of silica gel. Quantitation of the amount of ethylene glycol is made by rapidity of color development as well as rate of movement of the color band. The proposed system is specific for ethylene glycol and the catechol dimethyl ether gives a well defined lavender band which is extremely sensitive to ethylene glycol.
Author

N70-20086# Mound Lab., Miamisburg, Ohio.
MEASUREMENTS OF GASEOUS DIFFUSION COEFFICIENTS BY A MODIFIED TWO-BULB METHOD
G. A. Du Bro (M.S. Thesis—Dayton Univ.) 18 Apr. 1969 165 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1635) Avail: CFSTI

Diffusion coefficients of the systems He-3–He-4, He–Ne, He–Ar, Ne–Xe, and Kr–Kr, have been determined as a function of temperature using a modified two-bulb method. The modified method has been developed to investigate diffusion coefficients over a wide temperature range as well as having the capability for measuring isotopic diffusion coefficients. The theory of the method has been developed to account for removal of small non-negligible samples for concentration analysis. The temperature range for the experimental determination of He-3–He-4 and He–Ne diffusion coefficients has been extended more than 45 K. The results agreed well with other accepted literature values for diffusion and exhibited exceptional concordance with other transport properties. Theoretical diffusion coefficients have been calculated and have been shown to have reasonable agreement within the temperature range of this study.
Author (NSA)

N70-20097# California Univ., Riverside. Chemistry Dept.
THE CHEMISTRY OF THE BIS(PI-(3)-1,2-DICARBOLLYL) METALLATES OF NICKEL AND PALLADIUM
Leslie F. Warren, Jr. and Frederick M. Hawthorne 10 Nov. 1969 104 p Submitted for publication
(Contract N00014-67-A-0111-0021)
(AD-698136; TR-10) CSCL 7/3

The synthesis, reactions, and structures associated with the sandwich-bonded bis(pi-(3)-1,2-dicarbollyl) complexes of nickel and palladium, (M(n+)(1,2-B9C2H11)2(n-4)(M = Ni,Pd), and their carbon-substituted derivatives are discussed. The nickel and palladium bis(dicarbollyl) systems each contain species with the metal atoms in the formal +2 (d8, two unpaired electrons for nickel, diamagnetic for palladium), +3 (d7, one unpaired electron), and +4 (d6, diamagnetic) oxidation states. X-ray diffraction studies coupled with magnetic, spectral, and electrochemical data were obtained for structural information. The uncharged (pi-(3)-1,2-B9C2H11)2M(IV) derivatives are Lewis acids which form addition compounds with a variety of soft Lewis bases, e.g., halide ions, thiocyanate ion, naphthalene, etc. The C, C-dimethyl-substituted nickel and palladium systems, M(1,2-B9H9C2(CH3)2)2, exhibit facile thermal ligand rearrangement reactions leading to three isomeric series of complexes. In these isomerization reactions, a ligand carbon atom in the icosahedral surface was found to migrate away from the metal atom while remaining adjacent to the carbon atom in the open pentagonal face of the ligand. Similar rearrangements occur in the unsubstituted Ni(1,2-B9C2H11)2 complex at 360-400C in the vapor phase. Cyclic voltammetry, optical resolution studies, kinetic and nmr data and their roles in the structure elucidation of these complexes are presented.
Author (TAB)

N70-20109 Baylor Univ., Houston, Tex.
A STUDY OF ELECTRODEPOSITION REACTIONS IN ELECTROLYTES WITH RESTRICTED FLUIDITY
Kenneth Wayne Warren (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-7317

Electrodeposition from solutions of restricted fluidity was studied and the fluidity of the solutions was restricted by a sintered glass disk, a polymeric thickening agent, and an agar gel. Chronopotentiometric studies of these restricted solutions produced data which were found to fit an empirical second degree polynomial which expressed the transition time as a function of the ratio of the concentration of the electroactive species to the electrical current. Models of the electrode surface together with their adjacent solution layers were constructed. From these models, it could be seen that the electrodes were composed of a combination of thin layer electrode and linear diffusion electrode configurations. A theoretical equation for the system was derived by combining the expressions given in the literature describing the two individual electrode configurations.
Dissert. Abstr.

N70-20116 Cincinnati Univ., Ohio.
AN INVESTIGATION OF THE JAHN TELLER EFFECT ON SOME TRANSITION METAL IONS IN THE FLUORITE LATTICE
David C. Von Hoene (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-8358

Electron spin resonance is used to investigate some transition metal ions in the fluorite crystal structure. The compound actually considered was cadmium fluoride. The overall structure including basis is that of a f.c.c. lattice of cadmiums with origin at (0,0,0) and two f.c.c. lattices of fluorines centered at (1/4, 1/4, 1/4) and (3/4, 3/4, 3/4). There are eight fluorines and four cadmiums per unit cell which indicates the correct stoichiometry and results in four molecules per unit cell. Each fluorine is at the center of four cadmium, and what is more important to this problem each cadmium is at the center of eight fluorines. The anisotropic spectra were investigated using a superheterodyne X-band E.P.R. spectrometer. The main klystron is stabilized against another X-band signal derived from a step-recovery diode. A frequency counter is used to measure the microwave frequency and the magnetic field via a N.M.R. gaussmeter.
Dissert. Abstr.

N70-20119 California Univ., Los Angeles.
ELECTROABSORPTION AND ELECTROPHOTOLUMINESCENCE IN HgI2
Charles Clyde Coleman (Ph.D. Thesis) 1968 164 p
Avail: Univ. Microfilms: HC $9.60/Microfilm $3.00 Order No. 69-8094

Electroabsorption (EA) and electro-photoluminescence (EPL) were detected and studied in HgI2. EA has also been detected here in PbI2 and CdTe. HgI2 and PbI2 are insulating layer compounds. CdTe is a semiconductor. The purpose of this investigation was twofold. First to study EA in an insulator. Secondly, to test a qualitative prediction concerning the appearance of only a single positive peak in the EA spectrum. Previous studies in other materials have indicated exciton involvement in EA. The results of this investigation show that excitons are also involved in EA in HgI2. Furthermore, an exciton dependent form of EPL also appears in HgI2 under conditions which can obscure the observation of EA. This indicates that an EPL effect is related to the presence of excitons and that EPL can interfere with a study of EA. Dissert. Abstr.

N70-20134 Illinois Univ., Urbana.
STRUCTURE AND BONDING IN GROUP 2 AND 3 ORGANOMETALLIC CHEMISTRY
Jerry Lee Atwood (Ph.D. Thesis) 1968 169 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-10631

Group II and III organometallic compounds were studied by the techniques of X-ray diffraction and nuclear magnetic resonance. Bis(trimethylaluminum) dioxanate was investigated by means of a three-dimensional X-ray crystallographic study. The structure consists of two Al(CH3)3 groups bonded, one each, to the oxygen atoms in a dioxane ring, which is in the chair form. The structure of bis(dimethylamino)beryllium was determined. The molecule is a linear trimer containing both three- and four-coordinate beryllium atoms. Geometrical considerations point to dative nitrogen to beryllium pi-bonding with the terminal beryllium atoms. The ethyleniminodimethylaluminum trimer was shown to exist in the solid state as a cyclic trimer. The six-membered aluminum-nitrogen ring is puckered. The structure of tetramethoxytetramethyldialuminum-monomagnesium dioxanate is that of an infinite polymer. Dioxane rings in the chair configuration bridge the units together. Octamethyldialuminummonomagnesium is an electron deficient compound which shows, upon consideration of bond distances and angles, evidence of a certain ionic contribution to the bonding. Nuclear magnetic resonance work has characterized both this complex, and the beryllium analog in solution. Dissert. Abstr.

N70-20143# Naval Research Lab., Washington, D.C. Chemistry Div.
DETERMINATION OF TRACE QUANTITIES OF HALOGENATED HYDROCARBONS IN GAS SAMPLES
Federick W. Williams, Merle E. Umstead, and Enoch J. Johnson 6 Nov. 1969 18 p refs
(AD-698120; NRL-6964) Avail: CFSTI CSCL 7/4

Halogenated organic solvents are of particular concern in closed atmospheric situations such as nuclear submarines, spacecraft, and hyperbaric chambers due to their corrosive and toxic potential. A gas chromatographic on-column concentrating technique has been developed for the analysis of halocarbons in atmospheric gas mixtures, thus eliminating the use of cold traps. An important part of this analytical system is a coulometric detector which is specific for chlorinated, brominated, or iodated hydrocarbons. By making use of this specific detector and the on-column concentrating technique, gas samples can be analyzed quantitatively for chlorinated contaminant compounds at concentrations as low as 10 to 20 parts per billion by volume. Author (TAB)

N70-20162 South Carolina Univ., Columbia.
THE VIBRATIONAL SPECTRA AND STRUCTURE OF ORGANOGERMANES
Charles William Sink (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-5809

The infrared spectra of phenyltrichlorosilane, phenyltrichlorogermane, phenyltrichlorostannane, and pentadeuterophenyltrichlorogermane have been recorded from 4000 to 250 1/cm in the liquid phase. The far-infrared spectra of these molecules in either benzene or cyclohexane solutions have been recorded to 33 1/cm. The Raman spectra have also been recorded of the liquids and depolarization ratios have been measured. The assignment of the lowest observed Raman line in each spectrum to the torsional vibration is discussed. All spectra have been interpreted in detail and the vibrations have been assigned based on previous assignments for mono-substituted benzenes as well as expected band positions and depolarization values. The assignments of C6D5GeCl3 are shown to be consistent with those of C6H5GeCl3 by means of the Teller–Redlich product rule ratios. Dissert. Abstr.

N70-20164 Syracuse Univ., N.Y. College of Forestry.
STUDIES OF CF 3 RADICAL REACTIONS
Wen-Jiu Cheng (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-794

The CF3 radical abstraction and addition reactions have been studied in the gas phase and in solution. In the addition reaction to halo-ethylenes, the reactivity of the olefin was decreased, (a) by the presence of electron withdrawing halogen atoms, due to an increase in activation energy, and (b) by the blocking effect of bulky substituents, due to a decrease in A-factor. In radical reactions in solution, the validity of using mole ratio in rate equations was demonstrated. On the comparison of gas-liquid phase reactivities, the small effect of phase change on k sub 2/k sub 1 suggested that the solvation effect is compensating in competitive reactions. Photosensitized decomposition of hexafluoroazomethane in solution did not reveal any decrease in cage product, although triplet energy transfer was indicated. Probably spin inversion is fast compared with the rate of geminate radical combination. Dissert. Abstr.

N70-20166 California Univ., Santa Barbara.
HYDROGEN ADSORPTION ON ULTRAFINE PURE IRON POWDER
Ernest Phaynan Chock (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-1717

Ultrafine pure iron particles were prepared by thermal decomposition of iron pentacarbonyl vapor with hot helium. The particle size distribution of the prepared sample was extremely narrow, averaging 120 A diameter. Particle size distribution was analyzed by electron micrography and confirmed by the BET method and X-ray line broadening. Analyses by chemical means, electron diffraction, and Mossbauer effect all showed the iron to be of great purity. Adsorption isotherms of hydrogen on the iron particles at pressures between 6 cm and 76 cm Hg were measured. Adsorption was also measured in a low pressure range between 0.02 and 0.05 torr at 100 C and the heat of adsorption was found to be 17 kcal/mole of hydrogen adsorbed. Between −78 and −195 C adsorption increased with a decrease in temperature. Above 0 C up to 100 C, it increased with increasing temperature. At room temperature, approximately one hydrogen molecule per 150 iron surface atoms was adsorbed at atmospheric pressure. No infrared adsorption peak due to adsorbed hydrogen was observable at room temperature. Below −78 C, adsorption of hydrogen caused no change in the ESR spectra. Dissert. Abstr.

N70-20169 Iowa State Univ. of Science and Technology, Ames.
THE EFFECT OF GAMMA RADIATION ON THE CONDUCTIVITY OF SODIUM CHLORIDE

Michael Claudewell Jon Carlson (Ph.D. Thesis) 1968 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-4221

The electrical resistance of a sodium chloride crystal was measured prior to irradiation and during Co-60 gamma irradiation at constant temperatures within the extrinsic region. Both the steady state dc conductivity and blocked conductivity were measured. Dose rates of 2730, 5460 and 10900 rad/min were used. The steady state conductivity for sodium chloride decreases with increasing absorbed dose until a saturation level which is lower than the conductivity of the unirradiated material is reached. The saturation level is temperature and dose rate dependent. The activation energy for the steady state dc conductivity of sodium chloride during Co-60 irradiation at 2730 rad/min is higher than for the unirradiated material, but decreases with increasing dose rate. The blocked conductivity of sodium chloride increases during Co-60 irradiation. The increase in blocked conductivity is dose rate dependent, increasing progressively with increasing dose rate. The activation energy for the blocked conductivity decreases progressively with increasing dose rate. Dissert. Abstr.

N70-20170 California Univ., Berkeley.
COMBUSTION OF AMMONIA AND AIR IN A WELL-STIRRED REACTOR
David Terry Pratt (Ph.D. Thesis) 1968 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-3675

An adiabatic, well-stirred reactor was used to determine the overall chemical reaction rate constants for the near-homogeneous, gas-phase combustion of ammonia and air. The reactor was fabricated of castable zirconia (zirconium dioxide) as a modified conical combustion volume of 89 cu cm with one-inch thick walls. The premixed reactants were fed through a one-quarter inch zirconia or stainless steel tube, and the products exited the reactor through the annular passage formed by the space between the feed nozzle and the 0.6 inch diameter circular opening. Stirring was achieved hydrodynamically by the feed jet. Temperature in the reactor volume was obtained by weighted averaging of readings from a traversing ceramic-coated platinum/platinum-13 percent rhodium thermocouple. Steady-state temperatures in the combustion zone varied by at most 50 C with temperatures in the neighborhood of 1700 K, which indicated that adequate stirring was obtained. Dissert. Abstr.

N70-20176 Carnegie-Mellon Univ., Pittsburgh, Pa.
OXIDATION KINETIC STUDIES OF ZINC SULFIDE AS A SINGLE PARTICLE AND IN A FLUIDIZED BED REACTOR
Krishnamurthi Natesan (Ph.D. Thesis) 1968 249 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 69-3943

The oxidation kinetics of zinc sulfide, made from Santander concentrates, was studied over a temperature range with oxygen-nitrogen gas mixtures of different composition. Mathematical equations for various one-step models were formulated. In the case of single particles, the experimental data and the theoretical analysis showed that the process of oxidation was predominantly controlled by different transport steps during the course of the reaction. In the early stages of oxidation, the gas-phase transport was found rate-limiting while in the later stages, the transport across the oxide layer became the rate-limiting step. The effect of increasing temperature and oxygen mole-fraction of the gas mixture was to increase the reaction rate. For the oxidation process in a fluidized bed reactor, a mathematical model was proposed with emphasis on the solids conversion. Dissert. Abstr.

N70-20177 Pennsylvania Univ., Philadelphia.
ELECTRONIC SPECTRA OF AZINES
Charles Joseph Marzzacco (Ph.D. Thesis) 1968 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-5645

Part one of this thesis is concerned with the low energy singlet and triplet excited states of 9, 10-diazaphenanthrene, phthalazine, quinoxaline, pyrazine, pyrimidine, pyridazine and dimethyl-tetrazine. The singlet – singlet and singlet-triplet absorption spectra and the emission spectra of these compounds in pure and/or mixed crystals at 4.2 K are presented and analyzed. Part two of this thesis deals with the spectral manifestations of interactions between Npi* and pi pi* states of the same multiplicity. It is generally found that vibronic transition to the higher energy state of a pair of Npi* and pi pi* state are usually very broad compared with transitions to the lower state. Comparisons with aromatic hydrocarbons where pi pi* states overlap indicate that the broadening is less drastic in these cases. The relation of these results to the internal conversion process is discussed in detail. Dissert. Abstr.

N70-20181 Rutgers Univ., New Brunswick, N.J.
DIELECTRIC DISPERSION IN LIQUIDS
John Allen MacDonald, Jr. (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-7565

It is shown that the dispersions in the nonpolar liquids benzene, carbon tetrachloride, and carbon disulphide are described by a damped harmonic oscillator expression from the microwave region to the far-infrared region. The secondary dispersions in toluene and chlorobenzene are also described by a Lorentz resonance process. A model is proposed, based on an assumed temporary binding of molecules, which appears to explain the above dispersions. It is suggested that the primary dispersion in the polar liquids is better described by a Lorentz resonance process than by the Debye relaxation process, the dispersion being attributed to a mechanism of damped rotational vibrations. The results of an experimental study of dielectric dispersion in toluene at 20C and 40C at wavelengths from 9.21 mm to 2.53 mm are presented. Dissert. Abstr.

N70-20182 Texas A&M Univ., College Station.
DYNAMICS AND BACKFLOW CELL MODEL SIMULATION OF ISOTHERMAL TWO PHASE MASS TRANSFER PROCESSES INCLUDING NON-UNIFORM AXIAL MIXING, EQUILIBRIUM, AND HOLDUP EFFECTS
C. V. McSwain (Ph.D. Thesis) 1968 277 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 69-5141

The main objective of this project was to investigate the use of the backflow cell model for numerically simulating the steady state and dynamic behavior of continuous isothermal operations with single component mass transfer between two axially mixed phases. The backflow cell model is the discrete analog of the continuous diffusion model and allows one to compute the responses of a continuous mass transfer system by matrix methods on a digital computer. In order to determine the mixing parameters for the gas and liquid phases in a packed column, operated as a bubble bed, tracer studies were made. Liquid phase mixing was studied by injecting pulses of sodium chloride solution to the top of the packed column and monitoring the responses at several points along the axial dimension by the use of electrical conductivity probes embedded in the packing. Gas phase mixing was studied by using both pulse and step inputs of argon in the inlet carrier gas, air, and monitoring the responses by thermal conductivity. Dissert. Abstr.

N70-20192 California Univ., Berkeley.
THE CRYSTAL AND MOLECULAR STRUCTURES OF THREE BORON COMPOUNDS
Barry Goodwin De Boer (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-10274

The crystal and molecular structures of three boron-containing

compounds have been determined by X-ray diffraction studies of single crystal specimens. The structure was determined by Patterson and Fourier techniques and refined by a full-matrix least-squares procedure to a conventional R of 0.127 for 1175 scintillation-counter data (0.073 for the 935 non-zero data). The non-centric nature of the space group was demonstrated by the measurement of anomalous dispersion effects. The anion consists of two capped-square-antiprismatic B10 polyhedra joined by a pair of hydrogen bridges, one between each pair of equatorial fourrings. A list of thirteen possible isomers covering reasonable choices of bridge positions is presented together with their point symmetries. Dissert. Abstr.

N70-20211 Northwestern Univ., Evanston, Ill.
A FLOATING SPHERICAL DOUBLE GAUSSIAN ORBITAL MODEL
Robert Arthur Rouse (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-6984

The Floating Spherical Gaussian Orbital model (FSGO) has been proposed to predict the electronic and geometric structure for singlet ground states of molecules. FSGO postulates doubly occupied localized orbitals and proposes representing these orbitals with a spherical Gaussian function. The model is particularly attractive because it is completely ab initio; there are no assumed or empirically chosen parameters. In addition, the model is simple and meshes directly with a chemist's view of the chemical bond. The results obtained with this model (Single Gaussian) are very good, considering the over-all simplicity of the model. There were two areas, however, which needed improvement. The bond angles in water and ammonia were in error by 17%, indicating that orbital interactions were not being properly represented. And the energies were all about 85% of the Hartree-Fock values, indicating a poor approximation to the cusp condition at the nuclei, a major contributor to the total energy. Dissert. Abstr.

N70-20224# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
OPTICAL SPECTRA OF THE COBALT(II) ION AT SITES OF APPROXIMATELY OCTAHEDRAL SYMMETRY IN SEVERAL CHLORIDE CRYSTALS
Forrest Cubley Gilmore (Ph.D. Thesis—Tennessee Univ., Knoxville.) Jul. 1969 139 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2507) Avail: CFSTI

The optical spectra have been obtained of several crystals containing the Co(2 +) ion in an approximately octahedral environment of chloride ions. A modified Bridgman technique was used to grow large single crystals of all the compounds except RbCoCl3 and CsCoCl3. Very thin polycrystalline films of these two compounds were used. The spectra covered the energy region from 4000 to about 30,000 cm/1 and were measured at room temperature to approximately 5 K. Spectra of CsCoCl3 were also obtained above room temperature, up to the melting point of the compound. The spectra are interpreted and correlated using four-parameter ligand field theory and appear to be consistent with the assumption of octahedral symmetry about the Co(2 +) ion. An interpretation of the previously reported spectrum of CoCl2 in the 650 to 2000 cm/1 energy region is presented which results in the value of 420 cm/1. Author (NSA)

N70-20225 Pennsylvania State Univ., University Park.
LATTICE THEORY OF ALKALI HALIDE SOLID SOLUTIONS
David Lee Fancher (Ph.D. Thesis) 1968 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-5541

A theoretical investigation of properties was made, including heat of formation (heat of mixing), solid solubility, chemical spinodal, coherent spinodal, and bulk modulus. An extension of the substitutional impurity model was made so that the heat of formation of an alkali halide solid solution could be calculated over the entire composition range. The heats of formation of all alkali halide systems which crystallize in the rocksalt structure and contain a common anion or cation were calculated. The solid solubilities for several solutions were calculated at nonzero pressure from a free energy function. Working in reverse for NaCl-KCl from solid solubility data it is predicted that the elastic constant will show a five percent deviation from a linear interpolation of the values for the end members at a composition ratio of one-half. Spinodal decomposition is not greatly enhanced by the application of pressure. The substitutional defect model gave the correct order of magnitude for the initial slope of the bulk modulus versus composition, but the numerical results were not consistent for some of the systems. Dissert. Abstr.

N70-20229 Pennsylvania Univ., Philadelphia.
INTERFACIAL TURBULENCE AND THE MARANGONI EFFECT IN MASS TRANSFER
Benjamin Gross (Ph.D. Thesis) 1968 275 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.00 Order No. 69-5626

Interfacial turbulence during mass transfer was studied theoretically in order to extend the present stability theory to include unsteady-state diffusion in the undisturbed state, and experimentally using a unique diffusion cell that permitted observations of turbulence at both the wall and center areas of the diffusion chamber for extended periods of time. A linear stability analysis that combined the concepts of hydrodynamic stability, interface effects, and unsteady-state diffusion was employed to derive a set of equations which predict the stability of a two phase system to two dimensional roll cell disturbances at an initially quiescent interface through which solute was diffusing. The equations were valid for both unsteady and steady state diffusion and predicted that the growth rate of a disturbance should increase and its amplitude decrease with both increasing driving force and closer approach to the steady state from below. Dissert. Abstr.

N70-20248 California Univ., Berkeley.
THE N 14 NUCLEAR QUADRUPOLE SPECTROSCOPY IN MOLECULAR CRYSTALS
Sam H. Eletr (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-3596

Experimental and theoretical aspects of the N-14 nuclear quadrupole spectra were studied in several compounds to clarify the contributions of the various mechanisms responsible for the usually observed features. The sensitivity of the instrumentation is first discussed and the effects of the usual modulation techniques on the observed lineshapes and linewidths are studied. A quantitative theory is developed for the case of Zeeman modulation in order to relate the true linewidth to a simple features of the measured trace. This method is subsequently used in linewidth studies of NH3, ND3 and hexamethylenetetramine (HMT). The development of a new integrated circuits spectrometer is also described. Dissert. Abstr.

N70-20252 Indiana Univ., Bloomington.
THE CRYSTAL STRUCTURES OF CIS, CIS,CIS-CYCLONONA-1,4,7-TRIENE AND ITS TWO PI-COMPLEXES
Richard Burt Jackson (Ph.D. Thesis) 1968 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-4756

The crystal and molecular structures of three compounds containing the hydrocarbon system cis,cis,cis-cyclonona-1,4,7-triene, C9H12, are discussed. (1) The structure of the silver nitrate

complex of cis,cis,cis-cyclonona-1,4,7-triene, C9H12(AgNO3)3, has been solved by single crystal X-ray diffraction techniques. The molecule has the point group symmetry C sub 3v - 3m. The nine-membered carbon ring is in the crown conformation. (2) The structure of tricarbonyl-cis,cis,cis cyclonona 1,4,7 trienemolybdenum, C(9)H(12)MO(CO)(3), has been determined. The three carbonyl groups, together with the three double bonds of the ring, form an octahedral configuration about the molybdenum atom. Molybdenum is coordinated to the convergent ends of the ring p orbitals. (3) The crystal and molecular structure of the hydrocarbon cis,cis,cis-cyclonona-1,4,7-triene, C9H12, has been reinvestigated by single crystal X-ray diffraction techniques. The system is in the crown conformation, and the trigonal carbon angles are 126 deg.
Dissert. Abstr.

N70-20253 Louisiana State Univ., Baton Rouge.
SPECTROSCOPIC STUDIES OF beta-DIKETONES AND THEIR METAL COMPLEXES
Liang-Tsai Cheng (Ph.D. Thesis) 1968 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-4457

Electronic absorption and emission spectra of some beta-diketones, vanadyl complexes, and metal chelates were investigated. All the beta-diketones, acetylacetone, trifluoro acetylacetone, hexafluoro acetylacetone, and alpha-methyl acetylacetone exhibit a broad absorption band in the region 270-285 microns in 3MP and in EPA solution. The luminescences are attributed to dissociated enolate ions. Evidence for the existence of relatively stable tautomers of enolate ions of beta-diketones is discussed. An equilibrium study of the dissociation of hexafluoro acetylacetone in EPA solution is reported. The excitation technique was used to aid the identification of the emissions and absorption bands of vanadyl and the metal chelates. Emissions from the isomeric tautomers of canadyl bis-(benzoylacetonate) were also observed. A singlet-triplet excitation band is reported for vanadyl bis-(hexafluoro acetylacetonate) and sodium acetylacetonate. Spectral study indicates that sodium and beryllium acetylacetonates exist in the ion-pair form in EPA solutions. A possible energy transfer mechanism for metal chelates that can lead to multiple emissions is discussed.
Dissert. Abstr.

N70-20255 Syracuse Univ., N.Y. Coll. of Forestry.
STRUCTURE OF CELLULOSE GELS BY SMALL ANGLE LIGHT SCATTERING
Richard Leslie Coalson (Ph.D. Thesis) 1968 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-795

Water-swollen cellulose gels were prepared from cotton linters viscose. Solvent-exchange was used to replace water with a silicone fluid whose refractive index was a near match for cellulose. An empirical approach was used in which the scattered intensity vs. angle data was fitted by an equation involving six adjustable constants. A model provides for holes in the 0.4 to 0.8 micron range resulting from carbon disulfide droplets formed during the acid regeneration, gel particles in the 2 to 4 micron range which were in the viscose spinning solution as received, and precipitation holes 0.05 to 0.1 microns which formed during the coagulation step. Anisotropic light scattering showed that the cellulose around the CS2 holes was oriented. Anisotropic light scattering of gels stretched in the coagulated state showed that the cellulose around the precipitation holes could be oriented and X-ray analysis also gave evidence of crystalline orientation. A network model consisting of rod-like cellulosic elements was proposed and it was concluded qualitatively that stretching caused the rods to become more anisotropic.
Dissert. Abstr.

N70-20262 Michigan Univ., Ann Arbor.
IDENTIFICATION OF TRAPPING CENTERS IN CALCIUM TUNGSTATE
Helmut Arnold Koehler (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-2336

The first identification of three trapping centers in nominally pure calcium tungstate (CaWO4) are reported. This identification was made by correlating thermoluminescence (TL) and electron spin resonance (ESR) measurements. The TL curves of nominally pure CaWO4 after gamma-irradiation at 78 K showed three major TL peaks at approximately 155 K, 225 K, and 290 K. The trap depths of the trapping centers responsible for these three TL peaks were calculated by a method combining Randall-Wilkins' and Vasileff's theory of the thermal ionization of electrons from trapping centers. The calculated values are 0.38 ev, 0.55 ev, and 0.72 ev respectively. The ESR spectra of nominally pure CaWO4 after gamma-irradiation at 78 K indicated three groups of lines. Two groups were associated with paramagnetic tungsten, and the third group was identified with paramagnetic niobium.
Dissert. Abstr.

N70-20276# Utah Univ., Salt Lake City. Dept. of Chemistry.
STUDY OF METAL FLUORINE COMPLEXES Technical Report, Jun. 1964-Jan. 1969
Ronald O. Ragsdale Oct. 1969 148 p refs
(Contract AF 33(615)-2565)
(AD-687993; AFML-TR-69-243) Avail: CFSTI CSCL 7/4

A self-consistent set of sigma constants was developed to obtain linear free energy relations with titanium tetrafluoride complexes of the aromatic amine oxides. Several series of the diadducts of titanium tetrafluoride were studied with high-resolution fluorine-19 nuclear magnetic resonance spectroscopy. These series consisted of fluorotitanate complexes of formula TiF4.2(donor) and TiF5.(donor)(-), where donor represents an organic molecule (Lewis base) which coordinates through oxygen. The TiF4.2(donor) adducts included both TiF4.2D complexes in which the donors are identical, and TiF4.D,D complexes, in which D and D represent different Lewis bases. Cis-trans isomerism of the diadducts of TiF4 was also studied. Some complexes of TiF4 with substituted pyridines were also investigated. Fluorine-19 chemical shifts and spin-spin coupling constants were determined for most of the fluorotitanate complexes. The temperature dependence of the TiF4.2D spectra was also studied. The low infrared spectra of some SnF4.2D and TiF4.2D were also obtained.
Author (TAB)

N70-20288# National Inst. for Metallurgy, Johannesburg (South Africa).
SEPARATION OF HAFNIUM AND ZIRCONIUM OXIDES FROM URANIUM PRELIMINARY TO THE SPECTROGRAPHIC DETERMINATION OF HAFNIUM
A. Lagendijk, B. G. Russell, and T. W. Steele 19 Dec. 1968 4 p refs
(NIM-440) Avail: CFSTI

The sample is dissolved in HCl, and the Hf and Zr, together with other impurities, are separated from the uranium by liquid-liquid extraction of the cupferron complexes. The hafnium and zirconium are then precipitated with p-bromomandelic acid, and the precipitate is ignited to the oxide and submitted for spectrographic analysis. The procedure is applicable only to ammonium diuranate that has a high degree of purity. The method is adaptable to other pure uranium compounds if the solution technique is appropriately modified.
NSA

N70-20311 Cincinnati Univ., Ohio.
AN INVESTIGATION INTO THE EFFECTS OF SURFACE VISCOSITY AND BUBBLE COALESCENCE IN FOAM FRACTIONATION
Fang-Shung Shih (Ph.D. Thesis) 1968 246 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 69-6353

The theory for foam drainage and overflow rates proposed

by Leonard and Lemlich, and modified by Fanlo and Lemlich, was tested extensively. The tests appear to support the theory. Experiments were carried out with three aqueous systems, namely, solutions of bovine serum albumin, saponin, and Triton X-100. The third system, which was studied as a control, yielded good agreement with earlier results. The surface viscosities determined by the theory, through data from foam overflow and through those from steady state drainage, are consistent. Experimental data, including those from previous investigations, are well correlated by theory for both foam overflow and steady drainage. The volumetric foam density is correlated with the electrical conductivity ratio of foam to liquid. The volumetric foam density along the foam column is then shown to be uniform as predicted by theory. Fair agreement between theory and experiment is obtained for predicting the volumetric foam density with and without reflux. Dissert. Abstr.

N70-20313 Oregon Univ., Eugene.
A THERMAL CONDUCTIVITY STUDY OF HELIUM, CARBON DIOXIDE, ARGON, AND THEIR MIXTURES
Ross Leon Christensen (Ph.D. Thesis) 1968 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-6620

The thermal conductivity of carbon dioxide, argon, and helium was measured, along with carbon dioxide-helium and argon-helium mixtures at three temperatures between 300 and 400 K. A potential function was chosen which is a function of sigma, an intermolecular distance, and epsilon, the depth of the potential well. A family of sigma, epsilon/k pairs exists at each temperature. These points were plotted in sigma, epsilon/k space and three curves were obtained for each gas. The three curves for argon intersected and determined a unique, but not precisely defined, pair of values for sigma and epsilon/k for argon. The three curves for carbon dioxide did not intersect and the three curves for helium were extremely close together over the entire range of values of sigma and epsilon/k. Thus, unique values of sigma and epsilon/k for carbon dioxide and helium could not be assigned. The theory for gas mixtures is very complex and involves the dynamics of collisions between unlike molecules. Dissert. Abstr.

N70-20328 Tennessee Univ., Knoxville.
ELECTRONIC PROPERTIES OF LIQUID WATER IN THE VACUUM ULTRAVIOLET REGION
Linda Lee Robinson Painter (Ph.D. Thesis) 1968 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-7173

In order to determine the optical properties of water in the vacuum ultraviolet two general methods were used. In the first the reflectance of water in equilibrium with its vapor at 1 C was measured in the spectral region 1050 A to 3000 A for three angles of incidence. Light from a Seya-Namioka monochromator was reflected from a gold mirror onto either the water surface or a gold reference surface at the various angles and reflected specularly onto a coronene-coated photomultiplier. The optical constants were then obtained from a solution of Fresnel's equations. This method gave reliable values of n, but the reflectances measured in this way were not accurate enough to give good values of k. The second method involved placing water against the plane surface of a transparent semicylinder which formed one side of a sealed cell. Light is incident normally on the curved surface, reflects from the water-semicylinder interface and exits, again normally. Dissert. Abstr.

N70-20347 Pennsylvania State Univ., University Park.
CRYSTAL CHEMISTRY OF COMPOUNDS IN THE SYSTEMS: Tc-O, Ln2O3-ReO2, MeO-Cr2O3-O, Pt-O, Rh-O AND Au-O
Olaf Muller (Ph.D. Thesis) 1968 239 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-5578

The main purpose of the present study is to attempt to synthesize and characterize crystal-chemically a number of new oxides with rare or little known oxidation states. The system Tc-O was investigated and a number of new complex tetravalent technetium oxides were synthesized. Six Ln2O3-ReO2 systems and the system Y2O3-ReO2 were investigated at high temperatures. A number of new tetravalent rhenium compounds were obtained, especially of the Ln2ReO5 stoichiometry. The systems NiO-Cr2O3-O, MgO-Cr2O3-O and CdO-Cr2O3-O were studied in the temperature range 450-850 C and at oxygen pressures up to 3,500 atm. A common feature in all three systems is the existence of chromates of the type MCrO4 (all three with the CrVO4 structure) in the high oxygen pressure, low temperature portion of the phase diagrams. The systems Pt-O and Rh-O have been investigated at high oxygen pressures and temperatures. Three platinum oxide phases were found. Two crystalline oxides (AuOx and AuOy) have been found in the system Au-O at high oxygen pressures. Dissert. Abstr.

N70-20348# National Inst. for Metallurgy, Johannesburg (South Africa).
THE SPECTROPHOTOMETRIC DETERMINATION OF MIROGRAM QUANTITIES OF VANADIUM IN U3O8, UO3, AND UF4
D. F. Silverthorne, B. G. Russell, and T. W. Steele 6 Dec. 1968 7 p
(NIM-433) Avail: CFSTI

The uranium compound is dissolved and the vanadium separated by ion exchange. A PAR solution was used to form a color for spectrophotometric determination of the V. The procedure is applicable to UF4, UO3, and U3O8, in which the vanadium content is between 0.5 and 125 ppM. NSA

N70-20350 Illinois Univ., Urbana.
ELECTROCHEMISTRY OF MERCURIC SULFIDE COATED ELECTRODES, 1. ELECTROCHEMICAL BEHAVIOR OF BORON CARBIDE, 2
Joseph Harris Carney (Ph.D. Thesis) 1968 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-10655

The electrochemically induced exchange of sulfide between solution cations and mercury sulfide was investigated by linear sweep voltammetry, potential step chronoamperometry, and chronopotentiometry. The cations employed were cadmium (II), lead (II), zinc (II), cobalt (II) and nickel (II). Of the cations investigated, the cadmium (II) exchange approached most closely the simple thermodynamic model of linear sweep voltammetry. Potential step experiments produced no definite information concerning the exchange mechanism. It was found that for concentrations of cadmium (II), lead (II), or zinc (II) greater than 0.1 mM the cation adsorbed on the mercury (II) sulfide coated electrode, causing a prewave. It was demonstrated that a process involving reduction or oxidation of the boron carbide surface affects the reversibility of ferricyanide reduction. Metals such as silver, cadmium, lead, or thallium when deposited on the boron carbide surface cannot be completely stripped off electrochemically. Dissert. Abstr.

N70-20351 Case Western Reserve Univ., Cleveland, Ohio.
RETARDED AUTOXIDATION OF CIS-1,4-POLYISOPRENE
Kah Lam Ong (Ph.D. Thesis) 1968 306 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-9434

The oxygen-absorption plots versus time for cis-1,4-polyisoprene are generally characterized by the presence of two discrete linear stages of retarded autoxidation. Position of the well-defined break between the initial stage and the second, faster but still linear stage, with respect to the oxygen uptake, is dependent on the and nature of the antioxidant, but independent of oxidation temperature and antioxidant concentration. This

phenomenon was investigated by following the oxidation to a stage well past the first break point with periodic determination of the hydroperoxide concentration by the iodometric sodium iodide-isopropanol method, and infrared spectroscopic measurements of the antioxidant, carbonyl, and hydroxyl contents. The evolution of gaseous products (CO2 and H2O) was also measured. The iodometric peroxide method appears to be selective for hydroperoxide in oxidized polyisoprene. Dissert. Abstr.

N70-20359# Ludwig-Maximilians-Universitat, Munich (West Germany).
SOLID-STATE INVESTIGATIONS ON AMERICIUM COMPOUNDS
Nicolaus ter Meer (Ph.D. Thesis) 1969 97 p refs In GERMAN
(NP-18010) Avail: CFSTI

Topics covered include: discovery of americium, experimental techniques for work with americium and its salts, safety precautions, exhaust air treatment, gloveboxes, removal from radioactive fallout, roentgenographic methods for highly radioactive materials, preparation of pure americium 3 stock solution, preparation of americium 3 salts with organic anions, thermal decomposition in a mass spectrometer, investigations on the Mossbauer effect in compounds of Am-241, and summary of results and survey. NSA

N70-20419 Emory Univ., Atlanta, Ga.
THERMODYNAMICS OF LIQUID SOLUTIONS. PART A: SURFACE THERMODYNAMICS OF HYDROCARBON-ALCOHOL SOLUTIONS AND OF ORGANOSILICON SOLUTIONS. PART B: LIGHT SCATTERING STUDIES OF HYDROCARBON-ALCOHOL SOLUTIONS
Richard Showse Myers (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-5241

In order to study the surface thermodynamics of liquids and liquid solutions, the surface tension of pure liquids as a function of temperature and the surface tension of liquid solutions as a function of concentration were measured by the maximum bubble pressure method. Two types of solutions were investigated. Solutions of ethanol were compared and contrasted with similar solutions of t-pentyl alcohol, which has approximately the same surface tension but is larger with twice the molar volume of ethanol. Two types of hydrocarbons were used as solvents. The aromatic solvents used were benzene and toluene. The nonaromatic solvents, cyclohexane and methylcyclohexane, are slightly larger than the aromatic molecules but have somewhat lower values of surface tension. The Gibbs adsorption equation was used to calculate surface concentrations and surface excesses. In every case the adsorption of alcohol is greater in aromatic than in non-aromatic hydrocarbons. Also, the adsorption of ethanol is greater than the adsorption of t-pentyl alcohol in every hydrocarbon.
Dissert. Abstr.

N70-20445*# Notre Dame Univ., Ind. Dept. of Chemistry.
EXPLORATORY POLYMER SYNTHESIS Summary Yearly Report, 1 Feb. 1969 – 31 Jan. 1970
G. F. d'Alelio 31 Jan. 1970 110 p refs
(Grant NGL-15-004-001)
(NASA-CR-108912) Avail: CFSTI CSCL 07C

Research directed entirely to the synthesis of polymers of enhanced conductivity and to the exploration of the structural parameters which contribute to conductivity is reported. As the first approach to achieving this objective, polymeric azomethines which contain hetetocyclic aromatic tertiary nitrogen atoms as part of the linear chain were selected as candidates. Typical polymers are the polyazomethines related to the Schiff bases in which the benzene rings are replaced by pyridine rings. The research was divided into two parts. The first part deals with monomers, their syntheses and prototype reactions, essentially related to the reactions contemplated with polymers, have been evaluated with the monomers. The second part deals with the synthesis of pyridine-type Schiff base polymers and of certain specific derivatives therefrom; the synthesis will be based on chemistry established as definite by prototype studies. Author

N70-20452 National Lending Library for Science and Technology, Boston Spa (England).
ATOMIC ABSORPTION FLAME PHOTOMETRY. DESCRIPTION OF APPARATUS SPECIALLY DEVELOPED IN THE LABORATORY
G. Thilliez [1969] 25 p Transl. into ENGLISH from Chim. Anal. (France), v. 46, no. 1, Jan. 1964 p 3–22
(NLL-CE-Trans-5097-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

The technique of atomic absorption flame photometry, and apparatus constructed in the laboratory for implementing this technique, using a commercial spectrophotometer are described. Hollow cathode lamps of various designs are used as emitters. Measurements were made of traces of magnesium in zinc chloride, pure molybdenum, chromium, fertilizers, phosphates, and of calcium, chromium, manganese and a number of other elements. Author

N70-20470 National Lending Library for Science and Technology, Boston Spa (England).
THERMAL DIFFUSION AND MOLECULAR INTERACTION IN GASES
F. Van Der Valk 21 Nov. 1969 16 p refs Transl. into ENGLISH from Mass Spectrography, Kruislaan (Amsterdam), p 405–407
(NLL-MINTECH-Trans-T6463-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

A survey of the effects of molecular properties on the thermal diffusion in gas mixtures is presented. The way in which various transport coefficients are derived from kinetic gas theory is described. A few usable models of molecular interaction are mentioned, and some theoretical formulas for thermal diffusion factors are given. By means of a number of typical examples, the effects on the thermal diffusion factor of the concentrations, temperatures, and the relative differences in mass are demonstrated and a comparison is made between the experimental and calculated values of the thermal diffusion factor for various models. The existence of discrepancies between theoretical and experimental results and research aimed at proving the fundamental value of the theory are discussed. Some observations on diffusion in ternary mixtures are also given. Author

N70-20477 National Lending Library for Science and Technology, Boston Spa (England).
STANDARDIZATION OF THE DEUTERIUM CONTENT OF HEAVY WATER
P. Baertschi et al [1969] 18 p refs Transl. into ENGLISH from EIR Rept. No. 142
(NLL-WH-Trans-268-(9091.9F); EIR-142) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

An observed uncertainty of a few hundredths of a percent in the absolute determination of the relative D-content of D20 samples allows the manufacture of a D20 reference standard to an accuracy which appears desirable. The production and absolute determination of a D20 Primary Standard (S1) with a D20 content of 99.9983 + or – 0.0002 at.% proton resonance is described. By comparison of the I.R. absorption at 2.5 microns and comparison of the density by the flotation method, the D-content of three secondary standards (S2, S3, S4) was measured. The two comparison methods gave D-contents for all samples which agreed within the limits of error of + or – 0.002% of D. The O-18 and O-17 content, necessary for the density comparison were measured by mass spectrometer. Author

N70-20478 National Lending Library for Science and Technology, Boston Spa (England).
ELECTROCHEMICAL INVESTIGATION OF THE TRANSFER OF MATTER IN A LIQUID AT A GAS NOZZLE
Erich Weder 17 Dec. 1969 13 p refs Transl. into ENGLISH from Chem.-Ing.-Tech. (Berlin), v. 39, no. 15, 10 Aug. 1967 p 914–918
(NLL-RISLEY-Trans-1829-(9091.9F) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The transfer of matter from a liquid to a horizontal plate with a single gas nozzle in the center was studied by an electrochemical measuring method. The plate consisted of 11 nickel rings arranged concentrically round the nozzle and insulated electrically from each other, the electrochemical reaction taking place on their front faces. The transfer of matter could be measured with this probe as a function of the amount of gas passing through, as well as of the distance from the centre of the nozzle. The changes in the matter transfer coefficient with bubble formation were recorded with a high speed recorder. Simultaneous photography enabled the connection between matter transfer and bubble growth to be elucidated. Author

N70-20481 Utah Univ., Salt Lake City.
A KINETIC STUDY OF THE OXIDATION OF URANIUM MONOCARBIDE
John Lyman Ballif, III (Ph.D. Thesis) 1968 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-3303

Thin wafers of uranium monocarbide (UC) were exposed to oxygen at 400 to 800 C, with partial pressures from 18 to 300 Torr, to determine the rate of oxidation. The oxidation process consisted of three periods: a zero weight change period, a high rate nonisothermal period, and a lower rate isothermal period. The lower rate period occupied 80% or more of the total reaction time. The indicated mechanism consists of: (1) the nonisothermal reaction of dry oxygen with the UC surface, forming an oxide layer which quenches the self-heating reaction and returns the reaction temperature to ambient furnace temperature; (2) the molecular oxygen adsorbs on the oxide surface and dissociates on adjacent surface sites to form atomic oxygen; (3) the atomic oxygen diffuses through the oxide layer to form an intermediate activated complex which proceeds to form solid U3O8 and gaseous CO2 at the interface of the U3O8 and the UC; (4) a part of the U3O8 layer is continuously disrupted by stresses from the high specific volume of the U3O8, which results in linear kinetics. Dissert. Abstr.

N70-20495# Fulmer Research Inst., Ltd., Stoke Poges (England).
HEATS OF FORMATION OF LIGHT ELEMENT COMPOUNDS Progress Report, 1 Apr.-30 Jun. 1969
P. Gross, C. Hayman, R. H. Hayman, and G. C. Curme 28 Jul. 1969 7 p refs
(Contract AF 61(052)-863)
(AD-694566; R-163/35; PR-17) Avail: CFSTI CSCL 7/4

A study was made of methods of dissolving beryllium boride and the constituent elements in hydrochloric acid-bromine solution in a manner suitable for calorimetry. Author (TAB)

N70-20497# Purdue Univ., Lafayette, Ind.
MASS SPECTROMETRIC STUDY OF ION-NEUTRAL REACTIONS IN RADIOFREQUENCY DISCHARGES IN CARBON DIOXIDE
J. G. Collins, J. L. Franklin, and Steven M. Schildcrout Sep. 1969 32 p refs
(Contract N00014-67-A-0226-0005)
(AD-698192; SQUID-TR-RICE-8-PU) Avail: CFSTI CSCL 7/4

Abundances of positive ions and neutral molecules emanating from an active radiofrequency discharge in CO2 at pressures from 0.01 to 1 torr have been determined mass-spectrometrically. The data are used to evaluate rate constants for ion-neutral reactions occurring in the discharge. The results are in agreement with previous results for reactions occurring in an electron-impact ion source and in thermalized flowing afterglows. The large yield of O2(+) at the higher discharge pressures is attributed mainly to charge transfer to O2, the significance of which is enhanced by an increase in effective reaction time with increased CO2 pressure. Author (TAB)

N70-20611# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
INFLUENCE OF VOLATILE FUEL COMPONENTS ON VEHICLE EMISSIONS
B. H. Eccleston, B. F. Noble, and R. W. Hurn Feb. 1970 85 p refs
(BM-RI-7291) Avail: Issuing Activity

The effect of fuel volatility and front-end fuel composition on the amount and photochemical reactivity of automobile exhaust and fuel system evaporative emissions was studied. The study involved six gasolines; the base fuel, three fuels of varied volatility, and two fuels differing from the base and from each other in front-end olefin content. Data were obtained from 16 vehicles operated on a chassis dynamometer using a speed-load-time cycle that approximated a typical urban trip. Tests were made at ambient temperatures using a climate-controlled dynamometer room. The amount of hydrocarbon emission and its probable photochemical effect is expressed as weight of a moderately reactive material, ethylene. Emissions of oxides of nitrogen, carbon monoxide, and aldehydes were also observed. Results show that reduction of volatility from typical levels reduces both the amount and the reactivity equivalent of evaporative losses with a slight increase in exhaust emissions. Alternatively, reducing the amount of light olefin in the fuel had no effect on the amount of hydrocarbon pollutant but did significantly reduce the reactivity equivalent of the emissions. Neither volatility change nor chemical changes to the fuel significantly affected the nonhydrocarbon emissions. Author

N70-20646# Grumman Aerospace Corp., Bethpage, N.Y.
CHEMICAL REACTION IN LOW AND ZERO GRAVITY: A FEASIBILITY STUDY
John Fogarty and Sidney Butner *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 489-491 refs (See N70-20517 08-30)
Avail: CFSTI

This paper presents the results of a theoretical study to determine the effect of low and zero-gravity on chemical reactions, specifically catalytic polymerization of ethylene using transition metal complexes. Fixed bed, slurry reactor, and fluidized bed polymerization processes are compared under earth gravity and low or zero gravity conditions. Fixed bed polymerization under low or zero gravity does not offer any particular advantages or disadvantages compared to normal gravity processing. A theoretical model of the chemical and physical interactions of the gas and solid phases under normal and reduced gravity is described. This model is used to evaluate the potential performance of slurry and fluidized bed reactors. Techniques are proposed to adapt fluidized bed polymerization for zero-gravity operation. Author

N70-20647*# California Univ., Los Angeles.
INDUSTRIAL CHEMISTRY IN SPACE
W. F. Libby and Patrick Payton *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 492-498 (See N70-20517 08-30)
(Grants NGL-05-007-003; AF-AFOSR-1255-68)
Avail: CFSTI CSCL 07A

Chemical manufacture relates to a space environment as it relates to air-free chemical preparation. For example, oxygen-free copper would be a premium product. Author

N70-20613 National Lending Library for Science and Technology, Boston Spa (England).
THE RATE AND DEGREE OF POLYMERIZATION REACTIONS IN EMULSIONS [O SKOROSTI I STYEPYENI POLIMYERIZATSII V EMUL'SIYDKH]
L. G. Melkenyan [1967] 17 p refs Transl. into ENGLISH from Arm. Khim. Zh., (Russia), v. 21, no. 3, 1968 p 187–199
(NLL-RTS-5498) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

A complete model for polymerization is analyzed in which: (1) polymerization reactions occur mainly in the emulsifier; (2) monomer molecules are polarized in the adsorption layer, and orient themselves relative to each other so that activation of the monomer, and growth of the chain proceeds by a collective chain mechanism; (3) secondary reactions occur mostly within the polymer-monomer (PM) particles; (4) the concentration of the initiator in the emulsifier coating has a saturation limit; and (5) chain termination in a cell is caused by primary radicals. Results based on this model relating the rate and degree of polymerization to concentrations of initiator and emulsifier agree well with experimental data. Author

N70-20629*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACTIVATION ENERGIES FOR REACTIONS OF HYDROXYL RADICALS WITH HYDROGEN AND CARBON MONOXIDE
Edgar L. Wong and Frank E. Belles Washington Mar. 1970 18 p refs
(NASA-TN-D-5707; E-5159) Avail: CFSTI CSCL 07D

A mass-spectrometric stirred-reactor technique was used to measure the rate of the H2 + OH→H2O + H reaction at temperatures of 304, 403, and 503 K. The results yielded a certain rate constant. The activation energy of 4.2 + or − 0.3 kcal/mole (17.6 + or − 1.3 kJ/mole) was less than the previous estimated value of 5.15 + or − 0.15 kcal/mole (21.56 + or − 0.63 kJ/mole). The previous data for the CO + OH→CO2 + H reaction were reanalyzed by using the lower activation energy value for the outside + OH reaction to obtain an improved rate expression for the CO + OH reaction. Author

N70-20647*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE COMPUTATION OF PARTITION FUNCTIONS AND THERMOCHEMISTRY DATA FOR ATOMIC, IONIC, DIATOMIC, AND POLYATOMIC SPECIES
T. E. Horton (Mississippi Univ.) 1 Mar. 1970 39 p refs
(Contract NAS7-100)
(NASA-CR-108970; JPL-TR-32-1425) Avail: CFSTI CSCL 07D

The procedure for computing thermochemical data (specific free energy and specific enthalpy) from partition function is reviewed. Working expressions for approximate partition functions, specific free energy, and specific enthalpy of atomic, diatomic, and polyatomic species are presented. A review of energy level and heat-of-formation data for atomic, ionic, diatomic, and polyatomic species is given. Species composed of carbon, nitrogen, oxygen, hydrogen, and the noble gases were considered. A model for estimating the influence of differences in thermochemical data upon chemical composition is developed and used to assess the degree of approximation allowable for partition function computations. Author

N70-20651# Stanford Research Inst., Menlo Park, Calif.
OXIDATION OF AMMONIA CATALYZED BY MIXED OXIDES OF COPPER AND CHROMIUM Interim Report
S. H. Inami and H. Wise 15 Nov. 1969 17 p refs
(Contract Nonr-3415(00))
(AD-698152) Avail: CFSTI CSCL 7/2

The oxidation of ammonia catalyzed by cupric chromite ($CuCr_2O_4$) and cuprous chromite ($Cu_2O \cdot Cr_2O_3$) has been studied in order to examine the role of the copper ion valence state. The results at 400C indicate that Cu(2+) is a much better catalyst for this reaction in which nitrogen is the major product. Similar considerations apply to the complete oxidation of olefinic hydrocarbons. It is suggested that cupric chromite, commonly employed as an ignition and burning-rate catalyst for ammonium perchlorate solid propellants, plays the dual function of catalyzing the decomposition of ammonium perchlorate and the oxidation of ammonia and fuel molecules. Author (TAB)

N70-20678# Bureau of Mines, Amarillo, Tex. Helium Research Center.
COMPRESSIBILITY DATA FOR HELIUM OVER THE TEMPERATURE RANGE-5 C TO 80 C AND AT PRESSURES TO 800 ATMOSPHERES
Ted C. Briggs Mar. 1970 42 p refs
(BM-RI-7352) Avail: Issuing Activity

Twenty-two compressibility runs were made with helium over the temperature range −5 to 80 C and at pressures to 800 atmospheres. A Burnett apparatus was used. Data from the runs were fitted to a fourth degree polynomial equation of state in the pressure. All data for a particular isotherm were treated simultaneously. A temperature function was found to represent the parameters B and C. Compressibility factors determined by this investigation are believed to be accurate to better than 0.05 percent. Author

N70-20699# Pittsburgh Univ., Pa. Dept. of Chemistry.
A THEORETICAL INVESTIGATION OF THE VIBRATIONAL PROPERTIES OF HYDROGEN IN TRANSITION AND LANTHANIDE METAL HYDRIDES Final Report, 1 Dec. 1968–30 Nov. 1969
David P. Schumacher Nov. 1969 31 p refs
(Grant NSF GP-9394)
Avail: Issuing Activity

An experimental investigation of the infrared and Raman spectra of magnesium dihydride was made in Nujol and KBr matrices. Correlation of X-ray diffraction data with the spectra revealed no impurities due to interaction of MgH_2 with KBr nor the presence of free magnesium in the hydride. Interpretation in the infrared spectra is based on group theoretical methods which indicate IR and Raman active modes; the observed infrared window can be explained on the basis of the dihydride band structure. Author

N70-20705# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DEPARTMENT OF CHEMISTRY Semiannual Report, Dec. 1967–May 1968 [RAPPORT SEMESTRIEL DU DEPARTEMENT DE CHIMIE]
Dec. 1968 390 p refs In FRENCH
(CEA-N-1044; SAR-5) Avail: AEC Depository Libraries

Various analytical methods were developed for the chemical analysis of plutonium, chemical and electrochemical analysis in solution, optical emission methods, atomic absorption methods, X-ray fluorescence methods, and control of nuclear materials. Methods are described for the production of U and U_3O_8 by transformation of UF_6. The separation of transplutonium elements from rare earth, fission products, and Al in HNO_3 solutions by solvent extraction using D2EHPA in dodecane is described. Decalcification of sea water by dialysis, desalination of sea water by electrodialysis, and corrosion of various stainless steels by aerated NaCl solutions are reported, along with corrosion of various alloys by water and water vapor. Electrochemical studies were made on the deposition of W from fused fluoride salts; transport properties of Ag(+) and Cl(−) in fused chloride salts; deposition of nickel at high temperature under pressure; deposition of Au on Al-brass and Cu-Ni alloys; and the diffusion of hydrogen carbon steel under stress. NSA

N70-20709# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ROTATING FRAME SPIN LATTICE RELAXATION IN HEXAGONAL ICE
R. Blinc, G. Lahajnar, I. Zupancic, and H. Graenicher (Eidgenoess. Tech. Hochschule) Aug. 1969 5 p refs Submitted for publication
(IJS-R-565) Avail: CFSTI

The frequency and temperature dependence of the rotating frame proton spin-lattice relaxation time was measured in single crystals of hexagonal ice. The results show that the motion which determines proton spin-lattice relaxation is by an order of magnitude faster than the one determining dielectric relaxation, and can be described as Schottky defect diffusion of H2O molecules. Author

N70-20724*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTERPRETATION OF MICROWAVE SPECTRAL-ABSORPTION INTENSITY MEASUREMENTS ON PARTIALLY SATURATED LINES
William F. White and Wesley C. Easley Washington Mar. 1970 66 p refs
(NASA-TN-D-5726; L-6899) Avail: CFSTI CSCL 07D

A method has been developed which allows the use of intensity measurements made under other than maximum signal conditions. The method is based on the experimentally determined variation of signal with applied power. Measurement of the second derivative of the curve for variation of signal with power provides a test for many of the errors which can occur. The use of the method with data on isopropanol is illustrated. All necessary tables are included to allow interpretation of the measured derivatives of the curve for variation of signal with power. Author

N70-20750# Case Western Reserve Univ., Cleveland, Ohio. Electrochemistry Research Lab.
SPECULAR REFLECTION STUDIES OF GOLD ELECTRODES IN SITU Technical Report
T. Takamura, K. Takamura, W. Nippe, and E. Yeager 15 Jul. 1969 25 p refs
(Contract N00014-67-C-0389)
(AD-697673; TR-25) Avail: CFSTI CSCL 7/4

Multiple specular reflection has been used to examine in situ the gold electrode in acid and alkaline solutions. Reflectivity-potential and linear sweep voltammetry curves have been recorded simultaneously. The wavelength dependence indicates that the reflectivity changes with potential arise principally because of penetration of the d.c. electric field associated with the interface into the metal and subsequent interactions with the internal photoelectric effect in gold associated with a 5d to 6s band transition. The present results demonstrate that multiple specular reflection techniques are particularly well suited to in situ studies of the specific adsorption of ions, the formation of mono and poly-layer of oxides, and the Faraday adsorption of ions such as lead and cadmium to form monolayers of these metals in gold. Author (TAB)

N70-20758*# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Chemistry.
MECHANISMS FOR THE EFFECT OF ELECTRIC AND MAGNETIC FIELDS ON BIOLOGICAL SYSTEMS Semiannual Status Report, Jun. –Dec. 1969
H. Baessler, I. Teucher, T. M. Laronge, and M. M. Labes Dec. 1969 68 p refs
(Grant NGL-39-004-015)
(NASA-CR-108926; SASR-5) Avail: CFSTI CSCL 07D

The electric and magnetic field effects on the structure and properties of cholesteric liquid crystals were investigated. Work done is summarized in four manuscripts which cover: ac field induced cholesteric-nematic phase transitions, absence of helical inversion in single component cholesteric liquid crystals, helical twisting power of steroidal solutes in cholesteric mesophases, and the determination of the pitch of a cholesteric liquid crystal by infrared transmission measurements. J.M.C.

N70-20765 National Lending Library for Science and Technology, Boston Spa (England).
HEAT STABILISATION OF POLYPROPYLENE [TERMOSTABILILIZATSIYA POLIPROPILENA]
M. G. Pleshakov et al Nov. 1969 7 p refs Transl. into ENGLISH from Khim. Volokna (Leningrad), v. 6, 1968 p 70 –71
(NLL-RTS-5457) Avail: Natl. Lending Library, Boston Spa, Engl. 5s or 1 NLL photocopy coupons

For the heat stabilization of polypropylene, a number of sulfur compounds, used as antioxidant additives to various fuel oils, were tested. The relationship between the degree of polymer degradation and the amount and type of additive is shown. P-tert-amylphenol sulfide diphosphite was proved to be highest in efficiency as a heat stabilizer for polypropylene. J.A.M.

N70-20767# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
MIXED CONDUCTION IN IONIC CRYSTALS Final Report
John W. Patterson Mar. 1969 55 p refs
(Grant NSF GK-1551)
(ERI-449) Avail: Issuing Activity

Conduction in ionic crystals was studied for the materials ThO2, CaF2 and Zr(0.85)Ca(0.15)O(1.85). The investigations include a variety of solid electrolyte galvanic cell measurements as well as conductivity studies. Significant emphasis was placed on investigations to further the fundamental understanding of these materials as well as on additional applications of these materials as solid electrolytes. Author

N70-20770*# Techtran Corp., Glen Burnie, Md.
THE NON-EXISTENCE OF A HIGHER NICKEL CARBIDE [DIE NICHTEXISTENZ EINES HOEHERES NICKELCARBIDES]
Juergen Schmidt Washington NASA Mar. 1970 17 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 216, 1933 p 85 –98
(Contract NASw-2037)
(NASA-TT-F-12872) Avail: CFSTI CSCL 07B

The attempts to obtain a higher nickel carbide than Ni3C by careful carbonization of nickel with carbon monoxide have shown that such a higher carbide is not formed, but that carbon is absorbed above Ni3C without change in density, or the crystal lattice. Author

N70-20774*# Techtran Corp., Glen Burnie, Md.
ON CARBIDE HYDROLYSIS [UEBER CARBIDHYDROLYSE]
N. G. Schmahl Washington NASA Mar. 1970 10 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 40, no. 2, 1934 p 68 –70
(Contract NASw-2037)
(NASA-TT-F-12873) Avail: CFSTI CSCL 07B

An attempt is made to fill gaps in current knowledge of the process of carbide hydrolysis by more exhaustive treatment of the question of what hydrocarbon is obtained from a given carbide by hydrolysis and of the relationships existing during the process of hydrolysis. Special reference is made to uranium carbide and rare-earth carbides, but discussion is not limited exclusively to them. Author

N70-20779 National Lending Library for Science and Technology, Boston Spa (England).
NEW ABSORBENTS AND CLASSIFICATION OF METHODS

OF REMOVING SULPHUR DIOXIDE FROM INDUSTRIAL GASES [NOVYE POGLOTITELI I KLASSIFIKATSIYA SPOSOBOV OCHISTKI PROMYSHLENNYKH GAZOV OT DVUOKISI SERY]

A. M. Nagiev et al Nov. 1969 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Neft. i Gaz. (USSR), no. 11, 1968 p 108–110
(NRLL-RTS-5464) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

Liquid petroleum products were investigated for their ability to absorb sulfur dioxide. Experiments show that sulfur dioxide is absorbed as a result of chemical reaction with hydrocarbon compounds. Petroleum products which absorb sulfur dioxide become much lighter in color and different products have different absorption capacities. Classification methods are given for ways of extracting sulfur dioxide from waste gases. R.B.

N70-20780 National Lending Library for Science, and Technology, Boston Spa (England).

ELECTROCHEMICAL SYNTHESIS OF ISO-BUTYRIC ACID ON AN INDUSTRIAL SCALE [ELEKTROKHIMICHESKII SINTEZ IZOMASLYANOI KISLOTY V PROMYSHLENNOM MASSHTABE]

K. I. Kryshchenko et al Nov. 1969 9 p refs Transl. into ENGLISH from Khim. Prom. (Moscow), v. 45, no. 7, 1969 p 496–498
(NLL-RTS-5474) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

The oxidation of sulfuric acid in an aqueous solution with lead anodes whose surface becomes covered with a film of lead dioxide during electrolysis is described. The technology is discussed for electrochemical synthesis of isobutyric acid, its isobutyl ester, and the construction of electrolyzers. R.B.

N70-20792# Oak Ridge National Lab., Tenn.

STUDY ON REMOVAL OF IODINE FROM ATMOSPHERE BY SPRAY. PART 3: REMOVAL OF ORGANIC IODIDES BY SPRAY

Yukinori Nishizawa, Shigeo Oshima, and Tatsuo Maekawa 1969 10 p refs Transl. into ENGLISH from Nippon Genshirvoku Gakkaishi, (Tokyo), no. 11, 1969 p 262–267
(ORNL-TR-2240) Avail: CFSTI

The effectiveness of removal spray for organic iodine compounds is measured for 25 to 150 C. The organic iodine compounds tested include: CH3I; C2H5I; and C6H6I. The runs from 25 C to 80 C were conducted at atmospheric pressure under steady state spray process keeping the spray water and container temperature constant. The runs between 100 C and 150 C used the cooling process in which cold spray water was introduced into an atmosphere of saturated steam to simulate accident conditions. Author (NSA)

N70-20821*# Union Carbide Corp., Bound Brook, N.J. Chemicals and Plastics Operations Div.

SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT Addendum to Triennial Report, 1 Oct. 1968–1 Oct. 1969

James E. Potts, ed. 15 Oct. 1969 52 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951210)
(NASA-CR-109127; Rept-1) Avail: CFSTI CSCL 21I

The results of reaction studies on converting the end groups in ethylene/propylene telomers into useful functional groups are presented. Included, are the results obtained when terpolymerization of ethylene and propylene with a third monomer was used to prepare curable prepolymers. Prepolymers were obtained having exclusively terminal functional groups, randomly placed functional groups, and also products having functionality of both types. Author

N70-20835# Ballistic Research Labs., Aberdeen Proving Ground, Md. Interior Ballistics Lab.

THE ELECTRON SPIN RESONANCE SPECTRA OF RADICALS PRODUCED BY THE HYDROGEN AND DEUTERIUM BOMBARDMENT OF UNSATURATED ORGANIC COMPOUNDS AT 77 K

C. U. Morgan and Kevin J. White Oct 1969 26 p refs
(AD-697728; BRL-1453) Avail: CFSTI CSCL 7/4

The radicals produced by the interaction of unsaturated hydrocarbons with hydrogen atoms at 77K have been studied by electron spin resonance (ESR). The hydrogen atom adds directly to the double bond of ethylene, 1,3-butadiene, and benzene to produce the ethyl, 2-butenyl, and cyclohexadienyl radicals respectively. In the case of the interaction of hydrogen atoms with 1-butyne and 1,2-butadiene the methylallenyl radical was observed in each case. On bombardment of 1,4-cyclohexadiene and propyne with hydrogen atoms the cyclohexadienyl and allenyl radicals were observed. These last four reactions can be explained by assuming an addition reaction of hydrogen with the compound. The radical produced immediately abstracts a hydrogen atom from the parent compound to yield the observed stable radical. Author (TAB)

N70-20875*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RADIATION INDUCED PREPARATION OF PURE METALS FROM SOLUTION

Warren H. Philipp and Robert A. Lad *In its* Aerospace Structural Mater. 1970 p 229–237 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 07B

A new method has been developed at Lewis for the preparation of pure metals and compounds. It involves the bombardment of metal salt solutions with high-energy electrons (0.5 to 2 MeV). This bombardment promotes chemical reactions which cause the precipitation of the desired metal or compounds. Ten metals have been prepared from aqueous solutions by this method: They are cobalt, nickel, copper, zinc, palladium, cadmium, tin, antimony, thallium, and lead. The yields range from 3.5 to 126 grams per kilowatt hour of beam power. Furthermore, preferential deposition is easily accomplished by proper selection of conditions. For example, 99.998 percent copper was prepared from an acidic equimolar solution of copper and nickel salts. Also studied were the applications of this method to the production of mirrors, coatings, catalysts, radiographs, and anhydrous compounds. Author

N70-20876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN APPROACH TO A UNIVERSAL SPECTROCHEMICAL ANALYSIS

William A. Gordon *In its* Aerospace Structural Mater. 1970 p 239–249 (See N70-20860 08-17)
Avail: CFSTI CSCL 07D

A procedure is described for performing chemical analysis with an emission spectrometer without the need for standards. Random compositions of 20 metallic elements can be quantitatively determined from microgram sample weights. The procedure improves the utility of the emission spectrometer for support of materials research. Samples are prepared for analysis by dissolving them and depositing a fraction of the solution containing 10 micrograms of metal on a carbon electrode. A stable, direct-current arc in argon, developed for use in this procedure, is used to vaporize the silver chloride sample mixture and to excite atomic emissions from metal constituents. The silver chloride serves to enhance atomic emissions and also to provide a constant excitation environment for the metals in the sample. The light emitted from the arc plasma is detected by the spectrometer. The absolute microgram amounts of metal are derived from the spectrometer readout. Percentage compositions in the unknown samples are calculated from these data. Author

N70-20880*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
OXIDATION OF WI-52, A COBALT-BASE SUPERALLOY
Carl E. Lowell *In its* Aerospace Structural Mater... 1970 p 295-304 (See N70-20860 08-17)
Avail: CFSTI CSCL 07B

The oxidation of WI-52 was studied by combining weight gain, high temperatue X-ray diffraction, and high temperature microscopy experiments. The weight gain data followed a parabolic curve, implying a simple diffusion controlled reaction. High temperature X-ray diffraction, however, revealed a complex oxide growth pattern. The strongest phase initially was CoO with Cr2O3 and Co4Cb2O5 as minor phases. As the oxidation progressed, the CoO and Cr2O3 reacted to form a spinel, CoCr2O4. At the end of 100 hours, CoCr2O4 was by far the major oxide. High temperature microscopy showed complex oxide morphology changes. Initially, the grain boundary carbides, (Cb,W)C, oxidized rapidly. As this reaction slowed, the matrix oxidized uniformly, giving a color appearance of a thickening interference film. Finally, a nodular oxide nucleated in the middle of the matrix. This oxide spread laterally and in thickness until it covered all but the grain boundary oxide. Combining the results of all experiments led to a three-stage model of oxidation. Author

N70-20896# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Heisse Chemie
H-1 AND P-31 NMR INVESTIGATIONS OF THE EXTRACTION CHARACTERISTICS OF ORGANOPHOSPHORUS COMPOUNDS. 3: THE EXTRACTION OF HNO3 AND URANYL NITRATE BY TRIOCTYLPHOSPHINE OXIDE
R. v. Ammon, P. Dressler, and W. Troye May 1969 30 p refs In GERMAN
(KFK-958) Avail: CFSTI

In the extraction of H2O, HNO3, and UO2(NO3)2 by TOPO, the influence of concentration on the chemical shift of the alpha-CH2 protons, the phosphorus atoms, and the HNO3/H2O protons was investigated and compared with results for TBP. It was found that TOPO combines with H2O to form a stoichiometric 1:1 adduct. The compound TOPO · HNO3 is formed with a hydrogen bridge. The reaction between TOPO and UO2(NO3)2 yields UN · 2TOPO. NSA

N70-20931# Dayton Univ. Research Inst., Ohio.
THE CARBON-BROMINE STRETCHING FREQUENCIES OF MONO AND DIBROMONORBORNANES
John J. Lucier and Bartholomeus C. C. Ho Jun. 1969 31 p refs
(Contract AF 33(615)-3997)
(AD-697762; AFML-TR-69-156) Avail: CFSTI CSCL 7/4

The infrared spectra of mono- and di-bromonorbornanes have been studied. Mild interactions with the rigid and strained norbornane structure have been observed. The absorption frequencies range between 550-650/cm. Vibration frequencies are affected by steric factors, the electronic effect, the field effect and molecular orbital overlap. Author (TAB)

N70-20933*# National Bureau of Standards, Washington, D.C.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report, 1 Oct.-31 Dec. 1969
George T. Armstrong and Eugene S. Domalski 5 Jan. 1970 41 p refs
(NASA Order W-12-758; NBS Proj. 316-11-0429)
(NASA-CR-109137; NBS-10142; Rept-17) Avail: CFSTI CSCL 07C

Selected values were chosen for the heats of combustion and formation at 298 K for 174 organic compounds which were divided into the following classes: additional aliphatic amino acids, aromatic amino acids, steroids, aliphatic dicarboxylic acids, hydroxy aliphatic dicarboxylic acids, aromatic and phenylated acids, anhydrides, oligosac-charides, methyl esters of aliphatic and aromatic monobasic acids, dimethyl esters of aliphatic and aromatic dibasic acids, aliphatic and aromatic amides, organic sulfur compounds, and organic phosphorus compounds. Author

N70-20989# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PRODUCTION OF LIQUID HYDROGEN
I. V. Rozhkov et al 9 Jul. 1969 83 p refs Transl. into ENGLISH from RUSSIAN Report, (Moscow), 1967 p 1-198
(AD-693480; FTD-HT-23-1291-68) Avail: CFSTI CSCL 7/1

The production of liquid hydrogen, its liquefaction and its ortho-para-conversions, as well as specific features involved in the storage and transportation of this material are covered in detail in this report compiled from recent Soviet and other publications. The report deals specifically with the structural materials used in the fabrication of industrial installations, pumping and storage facilities. Cryogenic thermal insulation is covered, as are the rules of safety in connection with the handling of liquid hydrogen. A list of references, containing 170 entries, is provided. Author (TAB)

N70-21024*# Techtran Corp., Glen Burnie, Md.
STUDIES OF THE PROPERTIES OF HYDROCYANIC ACID. REPORT 5: THE DISCOLORATION AND WATER CONTENT OF LIQUID HYDROCYANIC ACID AND THE PREVENTION OF TRANSFORMATION [SEISAN SEIJO NI KANSURU KENKYU (DAI 5 HO). EKITAI SEISAN NO HENSHOKU, SUIBUN NARABINI HENSHITSU BOSHI-NI TSUITE]
Kiyoshi Onoda Washington NASA Feb. 1970 15 p refs Transl. into ENGLISH from Nippon Nogei Kagaku Kaishi (Japanese), v. 36, no. 7, 1962 p 575-580
(Contract NASw-1695)
(NASA-TT-F-12825) Avail: CFSTI CSCL 07B

It was determined that the speed of hydrocyanic acid transformation is proportional to its pH and that the extent of its transformation is detectable by changes in color tone. Colorimetric determinations of hydrocyanic acid water content can be made and used together with other methods in quality control. The regulation of hydrogen ion concentration to stabilize hydrocyanic acid by adding maleic anhydride and a small quantity of sulfur powder is proposed. Author

N70-21026# Washington Univ., Seattle. Chemistry Dept.
ISOMERIZATION OF VIBRATIONALLY EXCITED ALKYL RADICALS BY H-ATOM MIGRATION
E. A. Hardwidge and C. W. Larson 1 Nov. 1969 29 p refs
(Contract NONr-477(36))
(AD-697692; TR-13) Avail: CFSTI CSCL 7/4

The intramolecular isomerization by H-atom transfer, of ten vibrationally excited alkyl radicals was investigated. A chemical activation technique was used to produce the excited alkyl radicals in energy states near 45 kcal/mole. Reactions which proceed via a 6-membered ring transition state are most labile; a table of relative isomerization tendency as a function of ring size and H-type is given. Author (TAB)

N70-21028# California Univ., Los Angeles. Dept. of Physics.
ELECTRON IMPACT STUDIES OF ELECTRON CAPTURE AND EXCITATION NEAR THRESHOLD IN VARIOUS GASES Final Report, 1 Apr. 1968-30 Sep. 1969
Raymond Doak Rempt (Ph.D. Thesis) 30 Sep. 1969 105 p refs
(Contract F19628-69-C-0296)
(AD-697409; AFCRL-69-0367) Avail: CFSTI CSCL 7/4

A total collection ionization device of the Tate and Smith type has been employed to study resonance dissociative attachment by

electron impact on target gas molecules and to trap electrons having suffered an inelastic collision with a gas molecule. Resonance dissociative attachment is studied in carbon monoxide, hydrogen, nitrous oxide, oxygen, and methane. New structure is revealed in nitrous oxide and possibly hydrogen. Author (TAB)

N70-21029*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACADEMIA SINICA: COLLECTION OF RESEARCH REPORTS OF THE CHEMICAL PHYSICS RESEARCH INSTITUTE: SELECTED ARTICLES

Liang-Tai Chuan-Liang et al 19 Nov. 1968 29 p refs Transl. into ENGLISH from Chung-Kuo K'O-Hsueh-Yuan Hua-Hsueh Wu-Li Yen-Chiu-So Yen-Chiu Pao-Kao Chi-K'An (China), no. 4, 1965 p 37-42 and 55-65

(Contract F33657-67-C-1453)

(AD-696550; FTD-HT-23-738-67) Avail: CFSTI CSCL 7/4

Two papers are presented. In the first paper the following conclusions have been reached: (1) Using the pastening method, the infra-red spectrum of alpha-Al2O3.H2O after it is treated under different temperatures was recorded. According to the spectral line position changes of the bands of 1000-1280/cm the aluminum surface states are discussed. The result is that at 400C alpha-Al2O3.H2O is transferred to gamma-Al2O3. (2) It was discovered that under different temperatures, ethyl alcohol changes gamma-Al2O3 adsorption structure when the temperature increases from 35C to 300C. The adsorption state tends to transfer to the structure of ethyl aluminum acid from ethyl alcohol aluminum structure. The second paper summerizes the effect of various substituents on the infrared spectra of 5 gamma pyridines. Using these relationships, together with other methods one can determine the structure. The substituted radical when the radical group is small. Author (TAB)

N70-21065 National Lending Library for Science and Technology, Boston Spa (England).

ON DIFFUSION THEORY IN THE CRITICAL REGION [K TEORII DIFFUZII V KRITICHESKOI OBLASTI]

N. A. Stodolnik et al Nov. 1969 11 p refs Transl. into ENGLISH from Teplo i Massoperenos (USSR), no. 3, 1965 p 34-41

(NLL-RTS-5430) Avail: Natl. Lending Library, Boston Spa, Engl.: 20s or 3 NLL photocopy coupons

A statistical analysis of mass transfer phenomena in the critical state of a substance demonstrates the possibility of checking the fundamental thermodynamics of irreversible processes. It was directly demonstrated on binary systems that the chemical potential gradient is the motive force governing substance transfer. Study of ternary systems has shown that the effect of superposition of diffusional flows close to the critical point is greater than previously supposed. It was supposed that in the general case the mutual influence of flows is small and appreciable only in solutions of strong electrolytes. Close to the critical point, the part played by mixed phenomenological diffusion coefficients greatly increases and they become commensurate with the fundamental phenomenological coefficients. Author

N70-21084# Kernforschungszentrum, Karlsruhe (West Germany) Inst. fuer Material- und Festkoerperforschung.

TERNARY URANIUM-TRANSITION METAL NITRIDES

H. Holleck Jul. 1969 13 p refs Presented at 3d Intern. Conf. on Solid Compounds of Transition Elements, Oslo, 6-20 Jun. 1969

(KFK-1011; CONF-690631-1) Avail: CFSTI

A review of ternary uranium transition metal nitride properties and phases is presented. Comparisons are made in some cases between the nitrides and corresponding carbides. Emphasis is placed on the complex nitride phases involving U-V-N, U-Nb-N, and U-Cr-N. NSA

N70-21084 National Lending Library for Science and Technology, Boston Spa (England).

THE USE OF ELECTROLYSIS FOR THE SYNTHESIS OF OLEFIN OXIDES [PRIMENENIE ELEKTROLIZA DLYA SINTEZA OKISEI OLEFINOV]

A. P. Tomilov et al Dec. 1969 12 p refs Transl. into ENGLISH from Khim. Prom. (Moscow), v. 45, no. 6, 1969 p 413-416

(NLL-RTS-5473) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupons

An alkaline hydrolysis method is described for converting chlorhydrins to ethylene and propylene oxides. A literature survey is presented for different methods and apparatus for electrosynthesis of olefin oxides. The advantages of using the electrochemical over the chemical method are discussed. R.B.

N70-21093 National Lending Library for Science and Technology, Boston Spa (England).

OCCURRENCE, FORMATION AND PHASE TRANSFORMATION OF beta-FeOOH IN RUST

P. Keller 17 Dec. 1969 19 p refs Transl. into ENGLISH from Werkstoffe und Korrosion (West Ger.), v. 20, no. 2, Feb. 1969 p 102-108

(NLL-Trans-1159-(9022.9)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

The beta-FeOOH is formed in the presence of chloride ions as the primary oxyhydroxide in the corrosion of iron. It is formed from aqueous ferrous chloride. The concentration of chloride ions and the pH value do not have any primary influence upon the nature of the corrosion products, but due influence the quantitative ratio and the corrosion rate. The beta FeOOH is the most unstable of the three oxyhydroxides formed in the corrosion. Mixtures of alpha-FeOOH and hematite are formed at a pH greater than 4.5. In contact with metallic iron under conditions of low humidity, further beta-FeOOH is formed. This is very probably due to the variable chloride content of the beta-FeOOH. At high humidity, magnetite is formed. In both cases, the corrosion rate of the sample that contains beta-FeOOH is higher than that for the other oxyhydroxides. It is concluded that the presence of beta-FeOOH accelerates the corrosion of iron, due to its variable chloride content and low stability. Author

N70-21099 National Lending Library for Science and Technology, Boston Spa (England).

CONVECTIVE DIFFUSION IN A BINARY LIQUID SYSTEM IN THE CRITICAL REGION [KONVEKTIVNAYA DIFFUZIYA V DVOINOI ZHIDKOI SISTEME V KRITICHESKOI OBLASTI]

Yu. B. Ivanov et al Nov. 1969 13 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 32, no. 3, 1958 p 592-597

(NLL-RTS-5427) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

Diffusion coefficient reduction at the critical point in a binary liquid system was investigated using water-triethylamine solutions. This reduction caused a significant change in the heterogeneous process rate. The dissolution rate was determined by the triethylamine flow towards the surface of the rotating disk during convective diffusion. Mass flow at a rotating disk was shown to be dependent and was connected with the independent nature of mass transfer. J.A.M.

N70-21102*# Techtran Corp., Glen Burnie, Md.

STUDIES OF THE PROPERTIES OF HYDROCYANIC ACID. REPORT 1: POLAROGRAPHIC ANALYSIS OF THE HYDROCYANIC ACID POLYMER. REPORT 2: POLAROGRAPHIC AND ULTRAVIOLET SPECTROSCOPIC CONSIDERATION OF THE HYDROCYANIC ACID TETRAMER

Kiyoshi Onoda Washington NASA Feb. 1970 22 p refs Transl. into ENGLISH from Nippon Nogei Kagaku Kaishi (Tokyo), v. 35, 1961 p 1323-1331

(Contract NASw-1695)

(NASA-TT-F-12821) Avail: CFSTI CSCL 17D

The final product of the discoloration and transformation of hydrocyanic acid, a blackish brown powder was separated by extraction to produce 11% of ether soluble substances and 45% of an ether insoluble residue. The former were crystalline and on refinement produced a colorless needle crystal with a melting point of 179 C. As a result of elemental analysis, it was found that this substance was equivalent to (HCN)n and it was confirmed that it is (HCN)4. The crystal isolated from the transformation products of hydrocyanic acid by extraction had the molecular formula (HCN)4 and a molecular weight of 108. A method for quantitative analysis using ultraviolet spectroscopy was established. Spectroscopic and polarographic analysis reveals a conjugated double bond in the molecular structure of (HCN)4. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-19873*# Alabama Univ., University. Systems Engineering Group.

A STUDY OF MAJOR CODING TECHNIQUES FOR DIGITAL COMMUNICATION Final Report

Richard S. Simpson and Joseph B. Cain Jan. 1969 272 p refs (Contract NAS8-20172; Proj. 22-6509) (NASA-CR-102447; FR-101-102) Avail: CFSTI CSCL 17B

The performance and complexity of implementation of the major error-control techniques are analyzed. The white-Gaussian-noise channel and the generalized Gilbert channel are used in the performance evaluations. The results allow comparisons among the major coding techniques to be readily made. A new technique, concatenation with inner-code feedback, is presented, and its performance on the Gaussian channel is evaluated. Also, an upper bound on the average digit error probability of a linear block code and the probability distribution of the burst lengths on the generalized Gilbert channel are derived.These results are useful in evaluating the performance of error-control schemes. Author

N70-19968# Advisory Group for Aerospace Research and Development, Paris (France).

TECHNIQUES FOR DATA HANDLING IN TACTICAL SYSTEMS

Irving J. Gabelman (RADC), ed. Dec. 1969 364 p refs Proc. of the 15th Symp. of the AGARD Avionics Panel, Amsterdam, 4-7 Nov. 1968 (AGARD-CP-47) Avail: CFSTI

Reviewed are the latest developments and future projection of data handling techniques and their applications to military tactical systems. Avionic systems in data handling, information processing, and automatic control are discussed in detail. For individual titles see: N70-19968 through N70-19995.

N70-19970# IBM Italia, Milano.

COMPUTER CONTROLLED COMMUNICATION NETWORKS FOR TACTICAL SYSTEMS

F. Di Trapani and R. Roselli *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 7-20 (See N70-19969 08-07) Avail: CFSTI

Considered is a telecommunication infrastructure for communication integration in tactical command and control systems. Technical problems of data exchange between the several elements of the telecommunication network are discussed and the use of digital computers to increase the efficiency and effectiveness of human control capabilities is considered in accordance with operational military requirements. Routing optimization and error corrections are some of the problems best performed by digital computers. G.G.

N70-19973# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).

PHILOSOPHY AND STRUCTURE OF A MULTIRADAR TRACKING SYSTEM

H. von Issendorff and W. Pandikow *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 59-64 refs (See N70-19969 08-07) Avail: CFSTI

The multiradar system advocated combines the information of several radars, having overlapping ranges, for improved tracking capability. Operational advantages of the system constitute: (1) reduction of track position error to nearly the size of the plot position error; (2) transformation of track coordinates into a geographical coordinate system, even if there is no information on height; and (3) elimination of loss of track at inner and outer bounds of each radar range. Thus, identified tracks keep their information theoretically as long as the target is within the range of the total system. G.G.

N70-19974# Admiralty Surface Weapons Establishment, Portsmouth (England).

A LIMITED AREA RADAR AUTO-TRACKING SYSTEM

L. Moore *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 65-75 (See N70-19969 08-07) Avail: CFSTI

The experimental system is served by a general purpose digital computer and managed from a plan display showing raw radar and track management markers. A track is initiated manually by indicating a contact position to the computer which starts the data extraction process by defining an area, or "window", surrounding this position. The radar video within the window is quantized about a single threshold and fed to the computer for plot position extraction. Extracted plot positions are used to produce a track and the track co-ordinates position the window for the next extraction thus completing the cycle of events. All video within a window is assumed to belong to the track for which the window was produced. This eliminates formal association, but creates situations requiring special treatment when a track closes another video source. Experiments to optimize system parameters such as: quantizer threshold values and control, window size, and rules for plot extraction and tracking, to meet various requirements have been carried out. Fields of application tried so far are the sea surface, where targets are relatively slow but vary enormously in echoing area, and, to a lesser extent, sub-sonic air targets. General system feasibility has been proved and experimental results summarized. Author

N70-19976# IBM Italia, Milano.

AUTOMATIC INITIATION OF RADAR TRACKS IN TACTICAL SYSTEMS

P. Regi *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 91-104 (See N70-19969 08-07) Avail: CFSTI

Design, engineering, and implementation of the track initiation function for automatic radar tracking in tactical systems is evaluated with emphasis on complete automation of the process. Two types of initiation procedures with different degrees of automation are compared for their performances: (1) a manual-aided initiation, in which radar search and detection are achieved by an operator who feeds positional data of visually detected plots into a computer; and (2) automatic initiation, in which all operations are performed

by automatic equipment and the operator's tasks are limited to particular operational decisions. It is found that the automatic initiation process is advantageous but cannot alone completely meet operational requirements of tactical systems; manual aid is necessary where the operating conditions of the sensor impose certain limitations on the automatic system, and where the automatic decision process cannot substitute for all circumstances of the human decision process. G.G.

N70-19977# Societe d'Etudes des Systemes d'Automation, Paris (France).
SELF-ADAPTING SMOOTHING FROM DATA DELIVERED BY A TRACKING RADAR [LISSAGE AUTO-ADAPTATIF SUR LES INFORMATIONS FOURNIES PAR UN RADAR DE POURSUITE]
J. de Barbeyrac and P. G. Caumon *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 105-117 ref In FRENCH (See N70-19969 08-07)
Avail: CFSTI

Numerical filtering of signal information furnished by pursuit radar is discussed as a means of self-adaptive smoothing and optimization of signal characteristics. Radar signal processing has implicit in it numerous elementary errors of calculation and of rapid processing. Examples of problems associated with tracking by pursuit radar, i.e., temperature differences analysis and patterning are discussed. Application of numerical filtering to the trajectory phase by adjusting the number of points and the polynomial degree is demonstrated and recommended for error detection and minimization in pursuit radar systems. Transl. by M.H.E.

N70-19978# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
AUTOMATIC RADAR SIGNAL PROCESSING
Guenther R. Raab *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 119-129 (See N70-19968 08-07)
Avail: CFSTI

For automatic processing, both the primary and the secondary radar information must be converted by a radar plot extractor into a form suitable for computer processing and economical transmission to the operations center. The extractor acts as interface equipment and performs the following functions: (1) detection of targets; (2) determination of target positions; (3) processing of code information; (4) correlation of primary and secondary radar information; and (5) assembly of extracted data into information words. G.G.

N70-19979# Selenia S. P. A., Rome (Italy).
ANALYSIS OF AN ACCUMULATOR DETECTOR
Fulvio Marcoz *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 131-146 refs (See (N70-19968 08-07)
Avail: CFSTI

A mathematical model is developed for quantization of the radar sweep by accumulator detector. It is assumed that the shape of the beam is rectangular and that the target is non-scintillating; once the original video is quantized, further digital processing can be carried out on the basis of statistical detection theory and by using criteria for the realization of optimum detection. The normalized video consists of a Bernouilli sequence which is processed in the decision logic block; the memory stores the information of the preceeding sweeps. The logic of the accumulator can be summed up as follows: a counter adds a fixed count if the present return is a hit, and subtracts another fixed count if the return is a miss. G.G.

N70-19980# Compagnie Generale de Telegraphie sans Fil, Paris (France).
PHASE-CODING MTI
R. Carre *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 147-165 refs In FRENCH (See N70-19968 08-07)
Avail: CFSTI

Theory, design, and prototype operation of a phase-coding moving target indicator based on the phase measurement of received signals are described. The device is affixed to recurring pulse emitters and, in action, separates moving echoes from fixed echoes distinguishing between slowly moving objects such as the sun and raindrops. Discrimination is made by phase variations which appear between successive echoes of the moving targets. A digital apparatus and integrated circuits are the major components. Transl. by M.H.E.

N70-19981# Rome Air Development Center, Griffiss AFB, N.Y.
TRANSMISSION TECHNIQUE PERFORMANCE AND CHANNEL PARAMETER RELATIONSHIPS IN DATA COMMUNICATIONS
Robert C. Wasg *In* AGARD Tech. for Data Handling in Tactical Services Dec. 1969 p 187–189 refs (See N70-19968 08-07)
Avail: CFSTI

Selected modern techniques and recently evolved channel characterizations are surveyed and annotations are made for comparative evaluation of data transmission techniques. The communication channel through which the signal is sent is described as being, in general, a nondeterministic linear, time-varying filter with additive noise. Basic modulation techniques are treated briefly. Specific operational and newly developed FSK and PSK equipments with test results are discussed. The FSK equipments are the AN/FGC-29 and the Deltaplex system. The PSK equipments are the AN/FGC-54, ANDEFT, and TE-216. In conclusion, the importance is emphasized of highly automatic instrumentation and careful collection of information from which the channel status may be determined. Author

N70-19982# Mitre Corp., Bedford, Mass.
ERROR CONTROL FOR DIGITAL COMMUNICATIONS IN THE TACTICAL ENVIRONMENT
K. Brayer and W. F. Longchamp *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 191-207 refs (See N70-19968 08-07)
Avail: CFSTI

This paper considers error detection with retransmission and forward error correction for the transmission media used in the tactical environment: i.e., troposcatter and high frequency radio. The results of extensive error pattern measurements in these two media are reported. In the troposcatter channel, bursts with error densities up to 50% and lasting several seconds, followed by several minutes of error-free transmission, are not uncommon. In HF channels, bursts of similar length with short error-free intervals are frequently found; the error density is only 5%. A practical approach used in the design of coding systems (which prevent information degradation) incorporates channel testing. The error patterns that are collected are used in simulation of various coding techniques, with the objective of identifying the most promising Author

N70-19983# Signals Research and Development Establishment, Christchurch (England).
A COMPUTER CONTROLLED TELEGRAPH MESSAGE SWITCHING SYSTEM FOR USE IN A TACTICAL HEADQUARTERS
J. A. Clark and R. Little (Elliott Bros., Ltd.) *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 209-226 (See N70-19968 08-07)
Avail. CFSTI

The paper describes the development of an experimental model of a computer controlled telegraph message switching system for tactical use by the Army. The system provides automatic handling and routing of formal telegraph traffic. Connections to thirty duplex lines are available with a daily total traffic density of 2000 messages. Quick access storage is provided for one days

traffic to cover message retrieval requirements. It is intended that a fully developed system would be fitted in a one ton air transportable container body. The computer used as central processor is a standard with a 16K word core store. This is backed by an 8.4M bit magnetic drum which serves as buffer store and has enough capacity to store one days traffic. A description of the programme structure is given including simplified flow diagrams, estimates and measurements of programme timing and lists of core store occupancy. Author

N70-19984# Marconi Co., Ltd., Chelmsford (England).
TACTICAL DATA COMMUNICATION VIA SATELLITE
M. Telford *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 227-237 (See N70-19968 08-07)
Avail: CFSTI

Specifications and design outlines are given for a tactical data communication system that incorporates satellites and a form of centralized control system depending on deployment and zone signals considered. The basic earth stations have information capacities based on digital and speech channels. The use of existing military satellite communication bands between 7 and 8.5 GHz seems feasible. Radio frequency and transmit and receive parameters chosen determine the design of the satellites, along with total communication capacity and cost of launchers for a given satellite weight and orbit etc. G.G.

N70-19985# Rome Air Development Center, Griffiss AFB, N.Y.
IMPROVEMENTS IN COMMUNICATIONS, NAVIGATION AND IDENTIFICATION (CNI) BY INTEGRATION
Irving J. Gabelman *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 239-250 refs (See N70-19968 08-07)
Avail: CFSTI

Considered is a constellation of satellites, avionic subsystems, and ground receivers. The integrated communications system transfers information between the terminals through common modulation waveform employed by receivers located at all terminals of the system. The improved performance capability allows for reliable communications with high resistance to interference, a capability for accurate position location on a global basis, high traffic capacity, and identification and verification of information. G.G.

N70-19986# Royal Radar Establishment, Malvern (England).
HIGH-LEVEL LANGUAGES FOR RADAR DATA PROCESSING: A PRACTICAL APPROACH
J. G. Gibbs *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 251-258 refs (See N70-19968 08-07)
Avail: CFSTI

It is claimed that the usage of high-level programming languages has many advantages - speed and accuracy of program writing, ease of program testing, increased legibility of the program text, minimal difficulty in subsequent amendment of the program. Despite these and other claims, the use of language programming has not found great favor in the fields of radar data processing and air traffic control. This paper discusses the reasons for this apparent anomaly, and proposes an approach to the design of high-level language which is matched to the practical requirements of the class and problem discussed. Examples are given of the results achieved from this approach. Indications are given of the present lines of further development, and of the results which it is hoped to achieve. Author

N70-19991# Plessey Co., Ltd., Addlestone (England). Radar Div.
IMPROVEMENTS IN RADAR DATA HANDLING SYSTEMS
A. W. H. Carter *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 309-322 refs (See N70-19968 08-07)
Avail: CFSTI

This paper postulates that the application of new technologies can now be used to produce improved mobile radar data handling systems at reduced cost. To exploit these possibilities, large integrated circuit elements, known as Medium Scale Integration (MSI) and Large Scale Integration (LSI), are envisaged. Advantages of the proposed methods include the elimination of the need to re-design circuit elements as variations in system capacity are required and the prospect that each system can be computer-evaluated before a prototype is built. To demonstrate this contention, two present-day mobile radar data handling systems based on the use of discrete components are compared with a system using integrated circuits. Author

N70-19993# Service Technique des Telecommunications de l'Air, Paris (France).
DISPLAY SYSTEM VISU 4
G. la Rosa *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 329-337 In FRENCH (See N70-19968 08-07)
Avail: CFSTI

The modular basis and performance characteristics of the display system, VISU 4, are described. The visualization structure, presentation of images, and techniques for recording the images are outlined. Suitability of the console to tactical systems operations is suggested when combined with a calculator. Transl. by M.H.E.

N70-19995# Allied Naval Forces Baltic Approaches, Oslo (Norway).
AN OFFSET TARGET INDICATOR SYSTEM (OTIS) DERIVED FROM ANIMATED RADAR SURVEILLANCE
I. H. F. Martin and B. D. Parker (Decca Navigator Co., Ltd.) *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 349-359 ref (See N70-19968 08-07)
Avail: CFSTI

Described is a digital data link system that utilizes a variable bit rate (non synchronous) method to relay the aircraft's raw radar picture to a ground station. A rolling ball is used by the radar operator to position the electronic ring over the contact, thereby automatically computing its true position from information derived from the aircraft's navigational system. Information on that contact is then typed on the alpha-numerical keyboard and followed by either transmitting data or injecting it into a memory store. The position of the target is automatically checked for accuracy at the receiving station and marked on the plotting table, while information concerning that contact appears on the typewriter paper. G.G.

N70-20036 Purdue Univ., Lafayette, Ind.
DETECTION, RESOLUTION, AND ACCURACY IN THE RANDOM SIGNAL RADAR
Robert James Purdy (Ph.D. Thesis) 1968 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-7491

This study of the random signal radar considers its basic detection, resolution, and accuracy capabilities. The detection problem is considered because of the potential degradation in detection resulting from the randomness of the transmitted signal. However, upper and lower bounds on the radar error probabilities are obtained and these show that the effect is negligible for low input signal-to-noise ratios and reasonable integration times. Resolution is studied through a generalized random signal ambiguity function. One special case is Woodward's ambiguity function for deterministic signals while other cases consider random or noise type signals. Two random signals which are studied in detail are pulsed noise and continuous noise with a finite observation time. The general result here is that the random signal ambiguity function can be viewed as the sum of a tall, narrow central spike and a low, broad pedestal. Dissert. Abstr.

N70-20047# Army Foreign Science and Technology Center, Washington, D.C.
COMPARATIVE EFFICIENCY OF MONOPULSE RADAR DIRECTION-FINDING SYSTEMS
E. F. Sviridov 7 Nov. 1969 145 p refs Transl. into ENGLISH from an unknown RUSSIAN Report
(AD-698160; FSTC-HT-23-314-69) Avail: CFSTI CSCL 17/9

The book is concerned with the estimation of the efficiency of monopulse radar direction-finding systems. Circuits of monopulse systems are studied from the standpoint of the unified theory, signal processing rules are formulated, functional diagrams drawn in accordance with the processing rules are synthesized, and specifications for the basic elements of the functional diagrams at various signal shapes are considered. An analysis of the maximum accuracy of monopulse direction finding is carried out for a determinate signal and for a signal with random parameters at an arbitrary target location in the coverage area, and the functional diagrams of optimal resolvers at phase and amplitude direction finding are determined along with the principles of distribution of optimal estimation of angular position. TAB

N70-20091 Maryland Univ., College Park.
AN OPTIMUM THRESHOLD FOR FREQUENCY MEASUREMENT IN NOISE
Jaffrey Hamilton Rumbaugh (Ph.D. Thesis) 1968 40 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7627

This paper discusses the problem of obtaining an optimum value of threshold noise power per unit bandwidth for frequency measurement in the presence of noise. It is known that this threshold occurs when the noise power in the receiver bandwidth becomes as large as the signal power. Three systems are investigated: the conventional FM demodulator, the FM feedback demodulator which has the same general characteristics as the conventional demodulator at high input carrier-to-noise power ratios and an optimum calculating system which minimizes the r.m.s. frequency error. This system is compared to the FM feedback demodulator for establishing a lower bound on threshold causing noise power per unit bandwidth. From this value, the minimum value of input carrier-to-noise power ratio is found as well as the output signal-to-noise power ratio. This output ratio is a function of the deviation frequency and the sampling time (or audio bandwidth). Dissert. Abstr.

N70-20118 Colorado Univ., Boulder.
ELECTROMAGNETIC COMPATIBILITY OF RANDOM MAN-MADE NOISE SOURCES
Hjalmar Ottesen (Ph.D. Thesis) 1968 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-4365

A theoretical approach to the electromagnetic compatibility study of random man-made noise sources, which are scattered in space and overlapping in time is presented. The theory of random phasor sums has been applied to geometrically dispersed noise sources, and the resultant field-strength distribution is obtained at specified receiver locations. The receiver is assumed to have an omnidirectional antenna and a threshold level. Several simplified one- and two-dimensional mathematical models describing the physical dispersion of man-made noise sources in space are proposed, and the results of queueing theory are used to obtain the distribution of the number of noise sources contributing to the resultant field strength at a given site. The parameters of the fitted distributions are estimated from the measured amplitude-probability distributions, and from these estimates relationships between the parameters in each mathematical model can be established. Dissert. Abstr.

N70-20128 New York Univ., N.Y. School of Engineering and Science.
NULL RECEPTION SYSTEMS
Stephen Barry Dobrow (Ph.D. Thesis) 1968 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-4561

The nature of communication systems utilizing null reception procedures, i.e., any reception procedure which requires rejection of those portions of received messages which are excessively ambiguous, is investigated. Involved are the problems of decision criteria for both code words and individual digits, and the correction of code words containing both nulls and errors. It is shown that utilization of null reception improves the performance of communication systems. Criteria for making the null decision are investigated. In addition to the basic single-null-zone system for individual digits, the double-null-zone system and fixed-number-of-nulls schemes are investigated. Methods are developed for systematically correcting messages with errors and nulls in them. A complementary sequence method is described which, for the binary case, reduces the errors-plus-nulls case to that of errors only, for which a systematic decoding procedure exists. Dissert. Abstr.

N70-20203 Purdue Univ., Lafayette, Ind.
ELECTROMAGNETIC SCATTERING BY FINNED OBJECTS
Gary Michael Ruckgaber (Ph.D. Thesis) 1968 265 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.45 Order No. 69-7494

Solutions are obtained for the scattering of an incident plane electromagnetic wave by each of the following perfectly conducting objects: (a) an infinite circular cylinder having an attached sector, which, in the limiting case of zero sector angle, becomes a circular cylinder having a fin; (b) an infinite circular cylinder having two coplanar fins, which, in the limiting case of zero cylinder radius, becomes a strip; (c) a sphere having a fin, which, in the limiting case of zero sphere radius, becomes a circular disc. In each problem, the scatterer is described by sections of constant-coordinate surfaces and the space surrounding the scatterer is partitioned into several regions. The electromagnetic field in each region is expanded in a complete set of Hansen vector wave functions with unknown expansion coefficients. These sets of expansion coefficients are then determined by satisfying the boundary conditions. A review of scattering by the circular cylinder and the sphere is also presented. Dissert. Abstr.

N70-20219# Army Foreign Science and Technology Center, Washington, D.C.
STUDY OF A NONLINEAR PULSED PHOTOELECTRIC SYSTEM OF AUTOMATIC TRACKING
S. T. Shashkova 19 Nov. 1969 11 p ref Transl. into ENGLISH from Optiko-Mekhanicheskaya Promyshlennost USSR, no. 7, 1968 p 4-8
(AD-698081; FSTC-HT-23-152-70) Avail: CFSTI CSCL 17/8

An optical-photoelectric automatic tracking system is examined that follows a pulsed light source and is intended for the measurement of the angular coordinates and angular velocity of the line of sight. It is a pulsed nonlinear automatic control system. These properties are in its receiving element. The sensing element is divided into a series of areas operating on the yes-no principle, thus making it possible to use the simplest electronic device. TAB

N70-20243# TRW Systems Group, Redondo Beach, Calif.
RESEARCH STUDY AND DEVELOPMENT OF AN INTEGRATED CIRCUIT Final Report, Oct. 1966-Apr. 1969
Dan J. Dooley Dec. 1969 53 p
(Contract AF 40(600)-1188)
(AD-697959; TRW-07308-6001-R0-00; AEDC-TR-69-253) Avail: CFSTI CSCL 9/6

The design of a hybrid microminiaturized telemetry unit for use in gun launched projectiles is described. High peak accelerations during launch and short duration flight (2 milliseconds)

were two prime considerations during design. Initial tests indicated that this type of fm telemetry in the 150 mc frequency range would be feasible for aerodynamic measurements. Author (TAB)

N70-20283# Michigan Univ., Ann Arbor. Radiation Lab.
A THEOREM ON ELECTROMAGNETIC FIELDS IN SPHERICALLY STRATIFIED MEDIA
P. L. E. Uslenghi 27 Jan. 1969 2 p refs
(Contract F19628-68-C-0071)
(AD-697893) Avail: CFSTI CSCL 20/14

The electric permittivity and the magnetic permeability of a spherically stratified medium, for which the radial eigenfunctions of the TE and TM modes can be determined by solving the same differential equation, are derived. As a consequence, the calculation of the backscattering cross section of an inhomogeneous sphere is considerably simplified. Author (TAB)

N70-20348 New York Univ., N.Y. School of Engineering and Science.
A CLASS OF SIGNAL DESIGN PROBLEMS TO IMPROVE NOISE IMMUNITY OF DIGITAL COMMUNICATION SYSTEMS
Howard I. Silver (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-4578

In this thesis the technique of differential games is applied to a class of signal design problems. The technique is first applied to classical design problems involving amplitude, energy, and orthogonality constraints, which have been solved using analogous approaches. The techniques are then applied to the problem of signal design in a burst noise environment. A minimum Gabor bandwidth pulse is first designed on the basis of a fixed burst location and then averaged with respect to a uniform distribution of burst location. Procedures for generating M-ary alphabets are presented using this technique, and the results compared on the basis of bandwidth and signal separation in a noise environment that may include both gaussian and burst noise. An alternate approach to signal design in a burst noise environment is presented in the form of a two-player differential game. Dissert. Abstr.

N70-20394# Syracuse Univ. Research Corp., N.Y. Defense Systems Div.
THE R-390A/URR DIGITAL FREQUENCY READOUT UNIT Interim Report
Imants Bicevskis and William Emeny Jul. 1969 61 p ref
(Contract N00014-66-C-0118)
(AD-698190; DSD-R-253) Avail: CFSTI CSCL 14/2

The design and development of the R-390A/URR Digital Frequency Readout Unit is presented. The history of development including the techniques considered are discussed. Digital pulse subtraction, which was chosen as the most economical technique, is described in detail. The new approach to frequency readout uses the existing local oscillators of the receiver and, by a pulse subtraction process, extracts the input frequency of the receiver with an accuracy of plus or minus 20 Hz. Author (TAB)

N70-20410 Ohio State Univ., Columbus.
WAVEGUIDE APPLICATIONS OF IMPEDANCE SURFACES
Robert Bernhard Dybdal (Ph.D. Thesis) 1968 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-4879

The propagation in parallel plate and rectangular waveguides having impedance boundary conditions is investigated. A compatibility relation for the impedance boundary conditions in a rectangular waveguide that allow a separable form of solution has been developed. The constraints imposed by the impedance boundary conditions are utilized to provide model control for low loss configurations. A tall waveguide with cutoff vertical walls designed to reject cross polarized components has been developed. A waveguide, called the E-guide, is described which only supports TM modes and the modal structure has been experimentally verified. Propagation in a rectangular coax was also treated and a cutoff container to eliminate higher order modes was proposed. Waveguides with impedance surface structures within the wave guide cross section are considered and a means of enclosing a surface wave structure within a closed container that offers a potential low loss structure is also considered. Dissert. Abstr.

N70-20449*# Bellcomm, Inc., Washington, D.C.
ERROR-CORRECTING CODING TECHNIQUES FOR SPACE COMMUNICATION SYSTEMS
B. P. Tunstall 21 Jan. 1970 58 p refs
(Contract NASw-417)
(NASA-CR-108910; TM-70-2034-1) Avail: CFSTI CSCL 17B

Coded communication systems are surveyed and their applicability in space is examined. Theoretical results concerning maximum likelihood detection, channel capacity, probability of error, and code relisbility functions are reviewed. Orthogonal, biorthogonal, transorthogonal, BCH, and convolutional codes are discussed in conjunction with maximum likelihood, threshold, Fano, Jelinek, Viterbi, and Ng decoders. Performance curves for various encoder-decoder combinations as determined analytically and by computer simulation are given. Coded systems are shown to be potentially useful at earth orbital, lunar, or deep space distances on manned or unmanned missions. The use of coding in the IMP satellites, the Pioneer space probes, and the Mariner space probes is summarized. Coding gains of up to 5.5 dB have been achieved in these programs. Author

N70-20460# Army Foreign Science and Technology Center, Washington, D.C.
DISCRIMINATING AND PROCESSING INFORMATION IN DOPPLER SYSTEMS
G. I. Tuzov 12 Nov. 1969 276 p refs Transl. into ENGLISH from the Russian
(AD-698161; FSTC-HT-23-596-69) Avail: CFSTI CSCL 17/9

The book deals with radio systems which are intended for discriminating and processing information about the speed of movement of objects. The ultimate precision of doppler systems employing a continuous signal is evaluated and the structure of a receiving-measuring channel is analyzed together with the most important parts of it: tracking filters, converters for converting information about the speed of movement into a voltage and a digital code, and a system for signal search based on frequency. Author (TAB)

N70-20591# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATMOSPHERIC TURBULENCE AND RADIO WAVE PROPAGATION: SELECTED ARTICLES
A. S. Gurvich et al 13 May 1969 69 p Transl. into ENGLISH from Tr. Atmosfernaya Turbulentnost i Rasprostanenie Radiovoln. (Moscow), 1967 p 49
(AD-695920; FTD-HT-23-1510-68) Avail: CFSTI CSCL 17/2.1

Contents: Empirical data on the small-scale structure of atmospheric turbulence; Turbulence characteristics of wind speed and temperature in the boundary layer of the atmosphere; Turbulent exchange in the thermally stratified planetary boundary layer of the atmosphere. TAB

N70-20595*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
AN APOLLO APPLICATIONS PROGRAM DATA RELAY TERMINAL DESIGN STUDY Final Report
Feb. 1970 150 p refs

(Contract NASw-1982)
(NASA-CR-108946; SSD-00058R) Avail: CFSTI CSCL 17B

The results of a study for the design of a data relay terminal (DRT) to be incorporated into a Saturn workshop (SWS) as part of the Apollo Applications Program are given. The design requirements and constraints are summarized along with a description of the DRT configuration and performance. Detailed descriptions are given of subsystems. Author

N70-20599# Joint Publications Research Service, Washington, D.C.
CALCULATING THE COMPENSATING REFLECTOR IN A TWO-REFLECTOR ANTENNA WITH CIRCULAR SYMMETRY
I. V. Vavilova 4 Feb. 1970 12 p refs Transl. into ENGLISH from Antenny (Moscow), no. 5, 1969 p 72–81
(JPRS-49755) Avail: CFSTI

The geometric usage factor is investigated in two-reflector antennas with circular symmetry when the aperture of the smaller reflector, used to compensate for spherical aberration is less than 0.05 times the diameter of the larger reflector. A method is presented for calculating the smaller antenna for a two-reflector system with a large reflector in the form of a circular cylinder. Author

N70-20618*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERCOMPARISON OF THE MINITRACK AND OPTICAL TRACKING NETWORKS USING GEOS 1 LONG-ARC ORBITAL SOLUTIONS
James G. Marsh, Clarence E. Doll, Jr., Richard J. Sandifer (Wolf Res. and Develop. Corp.), and Wayne A. Taylor (Wolf Res. and Develop. Corp.) Washington Feb. 1970 67 p refs
(NASA-TN-D-5337) Avail: CFSTI CSCL 17B

STADAN Minitrack network data can be adequately analyzed using an optically determined standard orbit of 5-1/4 days based primarily upon GEOS I flashing-lamp sequence observations recorded by STADAN and SPEOPT cameras. A technique was devised to uncouple the refraction-dependent from the refraction-independent effects in the Minitrack residuals. Results indicate the Minitrack system as a whole to be free of any strong bias. Station-dependent systematic errors were not removed by the usual calibration procedures, and accordingly an optically-determined standard orbit would be a preferable method of calibrating individual Minitrack antenna arrays. A Minitrack orbit for the same time period as the optical orbit was obtained, and position differences between the two orbits produced an rms deviation of approximately 165 meters—a favorably small figure. Author

N70-20637# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
NOISE FIGURE AND GAIN OF LINEAR NETWORKS CONTAINING A SINGLE SINUSOIDALLY VARYING ELEMENT
D. D. Thornburg and B. J. Leon Sep. 1969 127 p refs
(Grant NSF GK-2988)
(TR-EE-69-28) Avail: Issuing CSCL 09D

A method is presented for determining the noise figure and gain for general classes of time varying linear systems containing a single sinusoidally varying element. These results are obtained for a general parametric amplifier employing a circulator and a general three port frequency converter. The generality of the system is obtained by utilizing a scattering matrix representation of these systems. The voltage-current relationships within the system are determined by the solution of a second order difference equation. The difference equation results from the frequency domain representation of the integral differential system equation. The noise figure and gain obtained by these methods are exact in that the solutions can be determined as precise as desired through the truncation of a convergent series. The upper bound on the error due to the remainder of the series can also be determined. Author

N70-20671# ADCOM, Inc., Cambridge, Mass.
ANALYSIS OF A PRECISION OMNIRANGE SYSTEM Final Report
Jerald F. Annese, Joseph M. Gutwein, and Elie J. Baghdady Sep. 1969 142 p refs
(Contracts FA-65-WA-1199; FAA-ARDS-589)
(FAA-RD-69-59; G-67) Avail: CFSTI

Analyses, laboratory experiments, and flight tests on a precision doppler VOR bearing measurement system are presented. The system incorporates an FM subcarrier to convey the bearing reference. A summary is given of the investigations leading to the selected schemes for modifying VOR station and aircraft receivers. Flight test results at several VOR stations are reported showing substantial improvements in angle accuracy. Compatibility tests demonstrated insignificant degradation in conventional receiver performance due to the modified signal. Author

N70-20688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIOFREQUENCY NOISE MEASUREMENTS IN URBAN AREAS AT 480 AND 950 MEGAHERTZ
Godfrey Anzic Washington Mar. 1970 17 p refs
(NASA-TM-X-1972) Avail: CFSTI CSCL 17B

The results of a limited survey of radiofrequency noise in the Cleveland, Ohio, area are presented. The measurements were made at 480 and 950 megahertz. A portable, self-powered radiofrequency noise measuring system was developed to measure and record the root-mean-square (rms) noise voltage at various urban sites. These sites included residential areas, apartment buildings, heavy and light industry, major street intersections, and low- and high-voltage distribution stations. Forty recordings were made. The noise observed was characteristically impulsive and random in occurrence. The principal source was automobile ignition. Author

N70-20707# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.
OPTIMIZATION OF NON-ADAPTIVE DIFFERENTIAL PCM SYSTEMS FOR MARKOV 1 SIGNALS
A. S. Rabinowitz 1 May 1969 92 p refs
(Contract F44620-69-C-0033; Proj. THEMIS)
(AD-697831; AFOSR-69-2981TR) Avail: CFSTI CSCL 9/4

The response of a non-adaptive differential pulse code modulation system to a first order Markov input signal is investigated through computer simulation techniques, and an attempt is made to optimize both the predictor and quantizer with respect to that signal. The criteria used are signal-to-quantizing noise ratio and entropy of the transmitted signal. Channel noise is not considered. Both uniform and nonuniform quantization are examined, but only linear prediction is used. The sequence of Markov-1 input samples is generated by passing uncorrelated Gaussian variables, which are created by a random number generator, through a simulated digital filter. Author (TAB)

N70-20722*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.
STEREOSCOPIC TELEVISION SYSTEM AND APPARATUS Patent Application
James L. Jones, inventor (to NASA) Filed 20 Oct. 1969 15 p
(NASA-Case-ARC-10160-1; US-Patent-Application-SN-867842)
Avail: CFSTI CSCL 17B

A stereoscopic remote viewing system is described, including a remote camera unit having means for projecting a pair of binocular images of a remote object through a common lens system

onto the sensitive face of a single television camera tube for transmission to a viewing unit having a television picture tube which may be viewed through a binocular image separation system that enables the viewer to see a stereoscopic image of the remote object. Means are provided in the remote camera unit for inverting one of the two images and then causing the two images to be projected mirror symmetrically onto the camera tube through the common lens system. Because of this image symmetry, distortion produced by the lens system or camera tube similarly affects both images. Means are provided in the image separation system of the viewing unit for transposing the transmitted inverted image and producing binocular separation of the images. NASA

N70-20733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSITION LOCATION SYSTEM AND METHOD Patent Application
Charles R. Laughlin and Roger C. Hollenbaugh, inventors (to NASA) Filed 28 Nov. 1969 11 p
(NASA-Case-GSC-10087-3; US-Patent-Appl-SN-880885) Avail: CFSTI CSCL 17B

A synchronous satellite relay system is described, deriving centralized air traffic control data and communicating via voice and digital signals between a multiplicity of remote aircraft including supersonic transports and a central station, as well as a peripheral ground station (or stations). Side tone ranging patterns, as well as the digital and voice signals, are modulated on a carrier transmitted from the central station and received on all of the supersonic transports. Each aircraft communicates with the ground stations via a different frequency multiplexed spectrum. Supersonic transport position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the aircrafts, with a plurality of different side tone techniques being employed, and relayed back to the transports. Common to all of the side tone techniques is Doppler compensation for the supersonic transport velocity. NASA

N70-20735*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANTENNA ARRAY PHASE QUADRATURE TRACKING SYSTEM Patent Application
Harold Dean Cubley, inventor (to NASA) Filed 5 Dec. 1969 17 p
(NASA-Case-MSC-12205-1; US-Patent-Appl-SN-882577) Avail: CFSTI CSCL 17B

The system input signals on two separate antenna elements in an antenna array are combined to form two processed signals with one representing the absolute value of the sum of the two antenna signals and the other representing the absolute value of the difference. The two processed signals are time multiplexed through a radio frequency switch operating at ten millisecond intervals to form a single input signal to a receiver which in turn detects amplitude modulation and forms an amplitude dependent signal to control a variable phase shifter circuit. The latter circuit automatically alters the relative phase between the two antenna signals whenever any amplitude modulation exists in the multiplexed signal. Relative phase shift of the antenna signals stops when the absolute value of the two processed output signals are equal to each other which occurs only when the two antenna signals are in phase quadrature. NASA

N70-20743*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FM DEMODULATOR THRESHOLD EXTENSION DEVICE Patent Application
William M. Conrad, and Frank J. Loch, inventors (to NASA) Filed 12 Nov. 1969 18 p
(Contract NAS9-1261)
(NASA-Case-MSC-12165-1; US-Patent-Appl-SN-875840) Avail: CFSTI CSCL 17B

A threshold extension device is described for improving the operating performance of frequency-modulation demodulators for input signals with relatively low signal-to-noise ratios by eliminating click-type noise impulses. The device serves to extend the threshold point of the demodulator in the direction of the lower end of the amplitude spectrum so as to accommodate lower values of input signal-to-noise ratio. NASA

N70-20755# Stanford Univ., Calif. Electronics Labs.
SIGNAL PROCESSING FOR PARAMETER DETERMINATION WITH LINEAR ARRAYS Technical Report
Crawford Warick Scott Sep. 1969 137 p refs
(Contract Nonr-225(59))
(AD-697652; SU-SEL-69-051; TR-1974-1) Avail: CFSTI CSCL 17/3

A new concept of signal processing is developed to determine the frequency and direction of arrival of a plane wave at a localized receiving point. The system is not restricted at any instant to observation of a subset of the admissible signals through a priori estimates of the received signal; furthermore, no estimate of signal duration is necessary. Two or more linear arrays are used to sample the electromagnetic environment at the receiving point. The signal sets so acquired are combined to synthesize signals of known form from which data related to the parameters of interest are extracted. The knowledge of the form of these signals is used to select preferred data values for computational parameter determination. This method of information management is important in that it supports the development of a measure of quality of the system performance. The measure of quality is in the form of two probability density functions that represent the most general measure of performance. A contribution to the field of Markov processes leads to recognition of a matrix form of the binomial probability density function. A complete theoretical analysis of the processing with two arrays is presented, with examples of the measure of quality for selected cases. The first step in an extension to higher order systems is presented without analysis. A direct analogy with previous efforts in this field illustrates the advantages to be expected of further investigation based on this concept. Author (TAB)

N70-20836*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
THE STUDY OF SYNCHRONIZATION TECHNIQUES FOR OPTICAL COMMUNICATION SYSTEMS Quarterly Report, 1 Oct. 1969 – 1 Jan. 1970
Robert M. Gagliardi Jan. 1970 6 p refs
(Grant NGR-05-018-104)
(NASA-CR-109087; QR-4) Avail: CFSTI CSCL 17B

Abstracts are given for contract-related research papers: (1) M-ary Poisson detection and optical communications; (2) pulse position modulated optical communication system design; and (3) representation of a continuous stochastic intensity by Poisson shot noise. E.C.

N70-20884# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC-TECHNICAL CONFERENCE OF THE PROFESSORIAL AND TEACHING STAFF OF THE MOSCOW ELECTROTECHNICAL COMMUNICATION INSTITUTE (SELECTED ARTICLES) [NAUCHNO-TEKHNICHESKAYA KONFERENTSIYA PROFESSORSKO-PREPODAVATELSKOGO SOSTAVA MEIS]
E. M. Zhurbenko et al 8 May 1969 16 p refs Transl. into ENGLISH from Proceedings of Conf. (Moscow), 1966 p 184-192
(AD-695355; FTD-HT-23-10-69) Avail: CFSTI CSCL 9/5

Contents: Analysis of the operation of a vertical log-periodic antenna with reflector for shortwave radio communication and

broadcasting; and Synthesis of shaped rebroadcast antennas, impedance type, for the amplitude-phase correction of incident electromagnetic fields. TAB

N70-20923# Tokyo Univ. (Japan). Inst. for Nuclear Study.
FIELD CALCULATIONS AND DISPERSION CURVES FOR PERIODICALLY LOADED STRUCTURES
S. L. Gluckstern Jul. 1969 22 p refs
(SJC-A-69-5) Avail: CFSTI

The complete analytical solutions for special models of periodic structures are formulated, and these solutions are correlated with structure compensation. A waveguide in which only one mode propagates, and in which the periodic perturbations are sufficiently far apart to neglect the interaction between them in all but the accelerating mode, is studied. A rectangular waveguide with periodic narrow posts extending part way across the aperture is considered. Also, a waveguide of arbitrary cross section loaded by periodic thin fins extending part of the way across the aperture is considered. In each case, general statements are made relating the dispersion curve to structure compensation. NSA

N70-20985# Institute for Telecommunication Sciences, Boulder, Colo.
CONFERENCE PROCEEDINGS OF ENVIRONMENTAL EFFECTS ON ANTENNA PERFORMANCE, VOLUME 2, BOULDER, COLORADO, 14-18 JULY 1969
James R. Wait 1969 117 p refs
(AD-692879) Avail: CFSTI CSCL 9/5

Topics included are: Electromagnetic theory; Boundary value problems; Influence of homogeneous half space; Ground screen effect; Antennas in plasma; Related environmental aspects; Design techniques for pattern control by ground screens. TAB

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-19760*# Bell Aerosystems Co., Buffalo, N.Y. Research Dept.
ADAPTIVE COMPUTING TECHNIQUES. REPORT ON OPTIMIZATION TECHNIQUES FOR UNIMODAL FUNCTIONS
Eric Schmitt 19 Aug. 1969 83 p refs
(Contract NAS8-21417)
(NASA-CR-102478) Avail: CFSTI CSCL 09B

An approach is proposed to the problem of minimizing or maximizing an unknown function of many variables, given only the ability to evaluate the function at chosen points. The best classical methods are reviewed, and it is noted that their strategy at a given point in a search depends very little, if at all, on the previous steps. Thus, valuable information which could lead to accelerated convergence is neglected. An adaptive step size random search which makes use of past information is introduced. A theory for the rate of convergence is formulated and confirmed by simulation in a digital computer. The computer time is shown to be less than that needed by non-adaptive methods, particularly for functions of many variables. The adaptive search method is shown to solve a trial problem in which function measurements are corrupted by noise, twice as fast as the best classical method. Author

N70-19882# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
PUNCHED-TAPE CODE AND FORMAT FOR NUMERICALLY CONTROLLED MACHINES
R. V. Miskell 5 Nov. 1969 15 p
(Contract W-7405-eng-26)
(Y-1702) Avail: CFSTI

A description of the newer punched-tape codes and formats for numerically controlled machines is presented. The description of the systems will assist personnel who are responsible for the procurement and operation of numerically controlled machines. Author (NSA)

N70-19888# Maryland Univ., College Park. Computer Science Center.
EDGE AND CURVE ENHANCEMENT IN DIGITAL PICTURES, 2
Michael Abbamonte, Emily G. Johnston, Yung H. Lee, Roger Nagel, Azriel Rosenfeld et al Jan. 1970 27 p ref
(Contract AT(40-1)-3662)
(ORO-3662-6; TR-70-103) Avail: CFSTI

A nonlinear edge detection scheme, involving products of linear edge detection operations is studied; results on edge detection in one and two dimensions are reported with an analogous scheme for detecting angles in chain-encoded curves. The possibility of using the edge detectors to detect texture edges is also discussed. Author

N70-19890*# Wolf Research and Development Corp., Riverdale, Md.
PRE-PROCESSING OF WALLOPS STATION AN/FPQ-6 GEOS 2 DATA
R. L. Brooks, and J. R. Vetter, eds. Feb. 1970 152 p refs
(Contracts NAS6-1467; NAS6-1628)
(NASA-CR-62076) Avail: CFSTI CSCL 09B

The preprocessing, operation and calibration procedures for the Wallops Station C-band radar system are presented. Static calibration is performed prior to and immediately following each mission, and the calibration sheet used for this pre- and post-calibration is shown. The data correcting, recording, and transmission procedures are described for use with the radar and meteorological logs for the GEOS-2 data. F.O.S.

N70-19891# Mitre Corp., Bedford, Mass.
MICROPROGRAMMING FACILITY
R. W. Cornelli 29 Jul. 1969 46 p refs
(Contract F19628-68-C-0363)
(AD-697998; ESD-TR-69-358; MTR-921) Avail: CFSTI CSCL 9/2

The microprogramming facility is designed to develop and explore the technology in the relatively new field of microprogramming. This document describes the facility. Author (TAB)

N70-19896*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
Z TRANSFORM AND THE USE OF THE DIGITAL DIFFERENTIAL ANALYZER AS A PERIPHERAL DEVICE TO A GENERAL PURPOSE COMPUTER
Donald Nalley 12 Aug. 1969 29 p refs
(NASA-TM-X-53886) Avail: CFSTI CSCL 09B

A feasibility study determined whether the Digital Differential Analyzer (DDA) can be used as a peripheral device; that is, a computer system programmed in Fortran IV or some other standard language in which certain manipulations could be accomplished on the DDA by calling a sub routine. In this study, consideration was given to Large Scale Integrator Circuits (LSI), because it was felt that suitable LSI would make the DDA a more feasible device. It appears that the DDA as a standard peripheral device with automatic patching is indeed feasible. However, implementation with LSI is questionable presently, but this may become feasible soon. A portion of time was allotted to the study of a control system analysis program using Z transform calculus. This work was performed to supplement the DDA work by extending the application of Z transform calculus to the analysis of the DDA. This

control system analysis program can be used to derive difference equations, which are necessary to accomplish real time flight simulation by digital computer techniques. The program may be used to further analysis of the DDA. Author

N70-19931# Houston Univ., Tex. Industrial Engineering Dept.
UHELP USER'S MANUAL
Darshan Singh, Charles E. Donaghey, and Prem B. Dewan Oct. 1969 27 p
(Contract N00014-68-A-0151)
(AD-698189; RE-11-69) Avail: CFSTI CSCL 9/2

A user oriented computer language for linear programming problems has been developed to overcome the difficulties encountered in using existing programs. The manual explains the use of the language. Author (TAB)

N70-19975# Compagnie Francaise Thomson-Houston, Bagneux (France).
STUDY BY REALISTIC SIMULATIONS OF BATTLEFIELD TACTICAL SYSTEMS DATA PROCESSING [ETUDE PAR SIMULATIONS REALISTES DE L'ELABORATION DE SITUATION DANS UN SYSTEME INFORMATIQUE POUR CHAMP DE BATAILLE TERRESTRE]
L. Gerardin, C. Goix, and C. Halna *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 77–90 in FRENCH (See N70-19969 08-07)
Avail: CFSTI

A realistic total battlefield environment is simulated provisionally by combining digital computer and numerical model techniques. Each specific terrain is characterized on plotted geographical coordinates. Enemy maneuvers are digitalized against these relief features from radar data as approximations on printed pictures. The provisional method is considered a useful means of battlefield ground simulation. Transl. by M.H.E.

N70-19987# International Business Machines Corp., Owego, N.Y. Federal Systems Div.
APPLICATION-ORIENTED MICROPROGRAMMING IN TACTICAL DATA PROCESSING
E. T. Walendziewicz *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 259-266 refs (See N70-19968 08-07)
Avail: CFSTI

This paper briefly discusses the characteristics and organizations of a hypothetical, current generation, microprogrammable, general purpose computer. Comparisons of processing speeds and storage requirements for conventional and microprogrammed approaches for several of the following specific applications are presented and discussed in detail: (1) aircraft phased-Array Radar Beam Steering; (2) spectral Analysis of Acoustic Signals; and (3) digital TV Display Data Processing. Processing speed improvements as high as ten-to-one are achievable in some applications when compared to standard computer programming implementations. This speed improvement results from incorporation of special problem-dependent instructions. The examples contained in this paper examine microprogramming for different perspectives ranging from computer system designer to operator. Author

N70-19990# Siemens A.G., Munich (West Germany).
A SMALL-SIZE COMPUTER FOR RADAR DATA PROCESSING
H. Goerling and R. Stark *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 299–308 (See N70-19968 08-07)
Avail: CFSTI

The tasks of radar data extraction and transmission in the radar site are investigated in some detail. These tasks are performed by a signal data converter and a general purpose computer. The computer is adapted by a special electronic control and a program suitable to this application. It outlines how the computer meets the essential requirements, viz. effective real time behavior, suitable structure, versatile data communication unit, compact layout, high reliability and maintainability. The program routines operating simultaneously and the associated data lists are described. Required total computer time and total storage capacity are estimated. A breakdown of both time and storage requirements shows that about 50 percent of the computer time is utilized by a simple version of the program and about 65 percent of storage capacity is occupied by the program and the associated lists. Hence it follows that a sufficient reserve for enhancements is provided. Author

N70-20135*# Rensselaer Polytechnic Inst., Troy, N.Y.
DESCRIPTION AND USER'S GUIDE: GAIN INITIALIZATION PROGRAMS GRADGN AND LERNGN Final Report, 4 Nov. 1968–3 Nov. 1969
Derek E. McBrinn 3 Nov. 1969 54 p refs
(Contract NAS8-21131)
(NASA-CR-102455) Avail: CFSTI CSCL 09B

GRADGN and LERNGN are Fortran 4 digital computer programs designed to automatically determine stabilizing feedback gains for linear time-invariant systems with output feedback. Both programs normally are started with all gains zero. If, for a specific problem, there exists prior information which indicates a better choice of starting gains, these gains can be used instead. GRADGN is considered more efficient than LERNGN, and should be tried first. If it fails and a solution is felt to exist, LERNGN should be tried or an attempt to determine a set of starting gains close to a stable region should be made. Both programs are designed only to find stabilizing gains. A trivial modification to either program would allow the degree of stability to be specified. Author

N70-20184 Tennessee Univ., Knoxville.
AN EFFICIENT, COMPUTER-ORIENTED METHOD FOR STABILITY ANALYSIS OF LARGE MULTIVARIABLE SYSTEMS
Wister Cordell Wright (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-7191

The proposed technique is essentially an analytical approach which operates on the coefficients of the equations that describe the system. The method is based upon a modification of the Mikhailov (Leonhard-Cremer) stability criterion. This modified criterion along with special programming techniques, which take advantage of the form of the system equations, constitute a very efficient analysis technique when implemented on the digital computer. To demonstrate the efficacy of the proposed method, four systems were analyzed for stability: a bipropellant rocket system, described by 2 differential equations; the Molten-Salt Reactor Experiment, described by 18 differential equations; the Molten-Salt Breeder Reactor, described by 34 differential equations and containing 15 pure time delays; and the evaporator, heater, and heat reject components of a multistage flash evaporator plant, described by 553 differential equations and containing 3 pure time delays. Dissert. Abstr.

N70-20212 Oregon State Univ., Corvallis.
LEARNING CONTROL OF LINEAR SYSTEMS WITH PERIODIC INPUTS USING A METHOD OF HARMONIC ANALYSIS
Sih Yao Cheng (Ph.D. Thesis) 1969 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-4085

A learning control system is described which is capable of controlling a linear plant subjected to periodic inputs, providing

that an upper limit for the order of the plant is known. Otherwise the characteristics of the plant and the inputs are unknown. Only one system variable is measured. The feature measurements used for recognition are the harmonics of the system error. The controller learns to obtain the best choice of control parameters of each environment by hill climbing and a pattern recognizing process. The controller also learns to construct a separation surface for the pattern classes in the measurement space by using a piecewise linear classification technique. The learning control system was simulated on an EAI 690 hybrid computer facility. Experimental results obtained from the simulation are presented. Dissert. Abstr.

N70-20213 Syracuse Univ., N.Y.
THRESHOLD DECODING OF CYCLIC CODES
Luther Day Rudolph (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-7771

It is well known that majority logic decoding, or more generally threshold decoding, is an efficient and easily implemented method of decoding certain classes of linear error-correcting codes. The investigation reported herein extends the range of applicability of threshold decoding for the class of cyclic block codes. The basic concepts of coding are reviewed briefly and classical approaches to the decoding problem are discussed. Majority logic decoding is introduced and a decoding algorithm is derived from the matrix representation of a code. A connection between majority logic decoding and combinatorial configurations is then established and a lower bound on the error-correcting capability of the associated codes is obtained. A class of cyclic codes, some new and some well known, are derived by analysis of the incidence matrices of finite projective and Euclidean geometries. A microwave implementation of this threshold decoder is discussed. Dissert. Abstr.

N70-20215# Argonne National Lab., Ill.
EBR-2: DIGITAL DATA ACQUISITION SYSTEM STUDY
R. W. Hyndman, R. O. Haroldsen, and J. R. Karvinen May 1969 33 p
(Contract W-31-109-eng-38)
(ANL-EBR-001) Avail: CFSTI

The Digital Data Acquisition System (DAS) for use with the EBR-2 is described. The system will display to the operators computed results for control and information. It also provides data storage. Functional requirements and necessary equipment are described. Author (NSA)

N70-20242# Illinois Univ., Urbana. Coordinated Science Lab.
A COMPUTER GRAPHICS PROGRAM FOR THE GENERATION OF HALF-TONE IMAGES WITH SHADOWS
Karl Cornell Kelley (M.S. Thesis) Nov. 1969 99 p refs
(Contract DAAB07-67-C-0199)
(AD-698124; R-444) Avail: CFSTI CSCL 9/2

An approach to the solution of the hidden line problem is to compute hidden surfaces. This paper describes a working set of programs which compute not only hidden surfaces but also shadows caused by a single light source positioned away from the observer. Author (TAB)

N70-20298 Virginia Polytechnic Inst., Blackburg.
FALSE LOCK IN SAMPLED-DATA PHASE LOCK LOOPS
Hatcher Edward Chalkley (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9925

The false lock characteristics of a sampled-data phase lock loop containing a phase detector with a sawtooth characteristic are investigated. The ideal processor of data operated on by such a phase detector nonlinearity is derived in open-loop form. A second system is proposed which is shown to approximate the operation of the ideal system with increasing accuracy for decreasing noise variance. A suboptimal system which uses feedback and a time-varying linear filter is analyzed. It was necessary to use a computer to perform the integration leading to the probability distribution of the error of this system. The bound on the probability of false lock for the ideal system is compared with the probability of a similar error for the suboptimal system. It is concluded that this bound is a conservative one. Dissert. Abstr.

N70-20377# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
SIMULATION OF A DIGITAL DETECTION SYSTEM USING A DIGITALLY CONTROLLED ANALOG COMPUTER
A. A. Pandiscio and D. W. Tufts Jul. 1969 55 p refs
(Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(AD-698122; TR-593) Avail: CFSTI CSCL 9/4

The usefulness of a digitally controlled analog computer in studying digital detection systems was examined. A program was developed for a computer equipped with parallel logic elements. Experience with the system shows it to be a very useful tool for such studies particularly because of the excellent man machine interaction and also because of a possible cost advantage. Author (TAB)

N70-20398 University of Southern Calif., Los Angeles.
AUGMENTED PARITY CHECK CODES FOR ENCODING OF ASYNCHRONOUS SEQUENTIAL MACHINES
Robert Mohammad Kashef (Ph.D. Thesis) 1968 255 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.00 Order No. 69-4531

One of the basic problems in the design of asynchronous sequential machines is the determination of an assignment of binary codes to the states of a machine in a way which avoids critical race conditions. Solutions to this problem can be found either by means of a coding algorithm or by the use of general codes capable of encoding any machine. The latter approach is investigated and is aimed at the specific problem of obtaining a race-free encoding with a minimum number of bits. Dissert. Abstr.

N70-20428# Illinois Univ., Urbana. Computer Science Dept.
DYNAMIC FOCUSING AND PINCUSHION CORRECTION CIRCUIT FOR THE ILLIAC 3 DISPLAY SYSTEM
Sergio Franco 12 Aug. 1969 11 p refs
(Contract AT(11-1)-1018)
(COO-1018-1188) Avail: CFSTI

Geometric distortions of a flat faced CRT can be corrected by a system generated by functions in the dynamic focusing and pincushion correction circuit for the ILLIAC 3 display system. In this method, X and Y deflecting fields are corrected by proportional terms. Correction fields are then symmetrical with respect to zero deflection. M.H.E.

N70-20474*# Rice Univ., Houston, Tex.
STUDY OF APPLICATION OF PRACTICAL PERFORMANCE CRITERIA FOR THE IMPLEMENTATION OF EFFICIENT ERROR-REDUCTION CODING Final Report
Frank L. Hubend, Ramesh C. Agarwal, and Forrest W. Fox Dec. 1969 61 p refs
(Contract NAS5-10774)
(NASA-CR-108908) Avail: CFSTI CSCL 09B

Sequential decoding, algebraic coding, and hybrid coding error reduction schemes are analyzed. In sequential decoding, error control for the discrete channel is examined, along with the potential of tree codes. Sequential decoding algorithms and their performance are described, including those of Jelinek and Fano. The presentation on algebraic coding centers on the Reed–Solomon erasure-correcting code. A definition of the code includes its field

elements and operations. Encoding and decoding implementation procedures are outlined. Hybrid coding schemes are described as well as modifications to the basic scheme. The probability of decoding errors due to bursts for a hybrid coding scheme is calculated and discussed. D.L.G.

N70-20478*# Ampex Corp., Redwood City, Calif.
DEVELOPMENT OF MAGNETIC LOGIC BATCH FABRICATION TECHNIQUES Final Report
C. H. Heckler, Jr. and N. C. Bhiwandker Feb. 1970 105 p refs
(Contract NAS1-7878)
(NASA-CR-66890; RR-70-04) Avail: CFSTI CSCL 09B

The process for making bimaterial multistage magnetic ferrite logic structures from the starting materials through the final firing cycle is described. The high coercive force material used in these structures has been developed to provide special partial set state magnetic characteristics. The second material was selected to have a low coercive force when bonded to, and fired with, the high coercive force material. The theory of operation of the multistage logic structures is discussed. The effect on operation due to use of materials having special partial set stage characteristics and the use of low coercive force material for selected magnetic paths is described. Test results of the bimaterial multistage ferrite structures are given, together with operating data for 8-stage ring counters, each built from two bimaterial multistage logic structures. A process for plating low resistance conductors on ferrite logic structures was developed. These conductors are joint free and can be made to form multiple turns through apertures 0.040 in. in diameter. Test results on ten structures with two-turn plated 0.004 in. copper conductors are presented. Author

N70-20503# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE 3RD ALL-UNION CONFERENCE ON INFORMATION RETRIEVAL SYSTEMS AND AUTOMATIC PROCESSING OF SCIENTIFIC AND TECHNICAL INFORMATION: SELECTED ARTICLES
B. I. Perelman et al 26 Jun. 1969 17 p Transl. into ENGLISH from Proceedings of Conf. (Moscow), 1966 18 p
(AD-695900; FTD-MT-24-76-69) Avail: CFSTI CSCL 09/2

Feasibility studies are discussed for designing a high-speed memory unit for storage, associative search, logic addition, multiplication, implication, and inversion, where information may be extracted in signed-magnitude or diminished radix complement codes. The unit is based on tunnel and reversed polarity diodes. A combination microfilm reader-copier is described for making copies on ordinary paper by an electrographic process. Author

N70-20563# Army Foreign Science and Technology Center, Washington, D.C.
ELECTRONIC COMPUTERS: PUNCH TAPE INPUT DEVICES. GOVERNMENT STANDARDS
17 Nov. 1969 16 p Transl. into ENGLISH from the Russian
(AD-697986; FSTC-HT-23-306-69) Avail: CFSTI CSCL 9/2

Punch tape input devices of electronic computers must be designed to meet government standards (GOST 13051-67). These requirements include: operating temperatures, humidity and air pressure ranges as well as specifications for the tape, the insulation, interference, etc. Testing for conformity to these requirements is outlined in detail. A thorough check must be made periodically as well as the production testing during manufacture. Requirements for labelling, packing, transport and storage are given in detail. TAB

N70-20606*# North American Rockwell Corp., Anaheim, Calif. Data Systems Div. of Autonetics.
STUDY OF SPACEBORNE MULTIPROCESSING, PHASE 1
Louis J. Koczela Washington NASA Feb. 1970 343 p refs
(Contract NAS12-108)
(NASA-CR-1446; C8-1476.10/33) Avail: CFSTI CSCL 09B

The results of a research study of multiprocessing computer organizations and their application to future space missions are presented. A manned Mars lander mission in the 1980 time period was investigated and computer requirements defined. Three multiprocessing computer organizations were developed: the multicomputer, the modular multiprocessor, and the distributed processor. An evaluation of the three organizations resulted in the modular multiprocessor as the optimum candidate for the selected mission; this organization was then subject to a detailed design investigation. Author

N70-20661*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DATA REDUCTION LABORATORY: AN AID TO THE SPACE SCIENTIST
Barbara A. Walton, Frank A. Keipert, and John J. Quann Washington Feb. 1970 13 p refs Presented at the 24th Natl. Conf. of the ACM Submitted for publication
(NASA-TN-D-5623) Avail: CFSTI CSCL 09B

The system processes data in real-time and is also capable of being programmed rapidly. The key to this system is the use of a combination of dialog and SYNTAX. Dialog is used where possible--in those areas that can be preconceived, where the possibilities are finite and either limited or subject to limitations--SYNTAX where not. The input and output, therefore, are defined through dialog, experiment computation by SYNTAX. Relatively complicated processors can be written, checked out, and operated in terms of hours rather than months. Anomalies in the data can be observed and compensated for; data correlations are facilitated. The time lag between launch and analysis is considerably shortened. Author

N70-20664*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AUTOMATIC ANALOG COMPUTER SCALING USING DIGITAL OPTIMIZATION TECHNIQUES
John Celmer and Mary Rouland Washington Mar. 1970 39 p ref
(NASA-TN-D-5595; G-950) Avail: CFSTI CSCL 09B

The automatic scaling program provides optimum scaling of any number of differential equations for an analog simulation. A set of equations is defined to have optimum analog scaling when the deviation from unity of the gain at each amplifier is minimized. Striving to satisfy this criterion, the program evenly distributes the gains as close to unity as possible, as limited by the coefficient matrix of the specific system of equations. Both linear and nonlinear systems are scaled with only a simple numerical input. Constraints may be placed on the maximum value of any equation or all the maximums may be considered arbitrary; the former procedure produces optimum scaling subject to constraints and problem coefficients, and the latter results in optimum scaling subject only to problem coefficients. The output provides a documentation of the maximum, the level, and the potentiometer readings and gains. Author

N70-20693*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
WIDE RANGE ANALOG-TO-DIGITAL CONVERTER WITH A VARIABLE GAIN AMPLIFIER Patent Application
Larry William Moede, inventor (to NASA) Filed 3 Nov. 1969 17 p
(Contract NAS7-100)
(NASA-Case-NPO-11018; US-Patent-Appl-SN-873259) Avail: CFSTI CSCL 09B

The output of the amplifier is supplied to a plurality of comparators, each one comparing the amplifier output with respect

to a different threshold level and providing a true output which affects the amplifier's gain. The combined outputs of the comparators represents the converter's output digital representation. NASA

N70-20708# Cornell Univ., Ithaca, N.Y. Center for Applied Mathematics.
ADAPTIVE SYSTEMS FOR PREDICTION PROBLEMS
Allen R. Hanson Sep. 1969 161 p refs
(Grant AF-AFOSR-1402-68)
(AD-697431; AFOSR-69-2146TR) Avail: CFSTI CSCL 9/2

The paper investigates classes of adaptive systems used as prediction machines in certain simple games. Ideally the machine should approach a state which will maximize its expected gain. The simplest machine takes the form of an urn, similar to the urn models of Polya and Friedman, but modified so as to form an adaptive system. The machine is characterized by learning parameters and a reinforcement scheme. The simplest machine is then extended to a machine with 2 to the nth power urns, each urn corresponding to one of the possible n-tuples of previous moves. This machine is further generalized to a machine which begins as a one-urn machine and splits states as information is accumulated. This machine is capable of growing until it comprises any number of urns. Many of these machines were simulated on a computer, playing against a variety of opponents. These results indicate that the prediction is not optimal but is considerably better than random guessing. A heuristic value of the limiting state for the one urn machine playing against a probabilistic opponent is obtained and the results of the simulation support this value. No convergence proof is available except for restricted values of the parameters alpha and beta. Author (TAB)

N70-20719*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
HARDLINE MONITORING SYSTEM Patent Application
Leo O. Richards and Walter E. Parsons, inventors (to NASA) Filed 4 Dec. 1969 62 p
(NASA-Case-KSC-10385; US-Patent-Appl-SN-882123) Avail: CFSTI CSCL 09B

A hardline monitoring system is described for monitoring a plurality of lines over which signals are transmitted in order to determine whether the characteristics of the lines are within certain predetermined tolerances. The monitoring system includes a programmer, an electronic scanner, an analyzer, a display and control panel, a signal generator, a computer interface unit, and a checkout computer. In operation, the electronic scanner, which is under the control of the programmer, scans a plurality of hardlines or cables over which the signals are transmitted. The programmer, in turn, couples these lines through the scanner to an analyzer which analyzes the signals to determine whether there is any distortion or deterioration of the line. If the signals being transmitted are out of tolerance, then the analyzer sends such information to a display and control panel to illuminate a lamp indicating such. Such information is also fed to a checkout computer through a computer interface unit and the programmer. A signal generator is provided for placing continuous data, FM, and wordburst signals on the line when necessary. NASA

N70-20727*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH SPEED MOVIE DATA ACQUISITION SYSTEM Patent Application
Nazem A. Habbal, inventor (to NASA) Filed 21 Nov. 1969 12 p
(Contract NAS7-100)
(NASA-Case-NOP-10745; US-Patent-Appl-SN-878730) Avail: CFSTI CSCL 09B

A system for digitizing a graphic display to determine the position and orientation of objects on it is described. The display is provided with a reference coordinate framework. A detection apparatus scans the display in a line by line manner. A counter is initiated when each line scan intersects a first reference line of the coordinate framework and normally continues to count until the scan intersects a second reference line. The counter values from each line scan are stored in a computer memory. Since the linear speed of each scan relative to the counting rate is known, information relating to the image distance about the start reference line is obtained. Information as to the image position in the orthogonal coordinate is obtained by counting the number of scans of known separation from a reference line segment to the point where the reference scan intersects the portion of interest. NASA

N70-20783# Stanford Research Inst., Menlo Park, Calif.
HIGH INFORMATION DENSITY STORAGE SURFACES
Quarterly Report, 1 Apr.-30 Jun. 1969
Louis N. Heynick Oct. 1969 44 p refs
(Contract DA-28-043-AMC-01261(E))
(AD-697768; ECOM-01261-17; QR-17) Avail: CFSTI CSCL 9/2

The program is devoted to the preparation and investigation of novel electron-beam-addressable storage mosaics and to the construction of an experimental, large-capacity, high-speed data-storage system utilizing such mosaics. At present emphasis is on so-called micro-cap mosaics, the elements of which are discrete, submicron-size capacitors at the bases of regular arrays of closely spaced holes in molybdenum/alumina/molybdenum film sandwiches on sapphire substrates. Author (TAB)

N70-20827# Dartmouth Coll., Hanover, N.H. School of Engineering.
DESIGN OF AN ANALOG INPUT TERMINAL FOR A TIMESHARED COMPUTER
Richard A. Livingston 9 Jun. 1969 67 p refs
(Contract F44620-68-C-0015)
(AD-697807; AFOSR-69-2990TR) Avail: CFSTI CSCL 9/2

A system using timesharing is proposed as an alternative to using a small single purpose computer to make measurements, perform calculating and display results. A preliminary feasibility study involving both cost analysis and determination of data requirements is performed. Based on the feasibility study, a device is designed to handle 4 channels of analog DC voltages with a capacity to make a full set of measurements every 12 seconds. The output is serial ASC11 compatible with GE 635 BASIC. Author (TAB)

N70-20847# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
DATA-LOG: A DEVICE FOR CONTROL OF THE LOGIC FUNCTION IN THE DATA SYSTEM
H. Brueckmann, P. Fluck, H. Matthaey, and L. Schaenzler Dec. 1968 26 p refs In GERMAN
(KFK-897) Avail: CFSTI

DATA-LOG is the central unit of the data acquisition system DATA. The system accepts simultaneously up to five independent analog signals. These signals might be derived from a single event in nuclear reaction studies. The five independent parameters may for example represent information on energy loss, time-of-flight or dE/dx for a single coincidence event. Five ADC's integrated into DATA digitalize the information with an accuracy of 12 bit/parameter. The whole digital information (up to 48 bit) is transferred to a CDC-3100 computer. The unit DATA-LOG is responsible for the control of the data flow between experiment and computer and directs a selectable part of the information to a separate memory or multichannel analyzer for monitoring purposes. DATA-LOG generates and accepts all logical signals being necessary for the common-operation of the five ADC's, the memory, and the computer. Author (NSA)

N70-20849# Kernforschungszentrum, Karlsruhe (West Germany).
ON-LINE COMPUTER SYSTEMS FOR EXPERIMENTAL NUCLEAR PHYSICS AT KARLSRUHE

S. Cierjacks, G. Ehret, H. Hanak, K. Krueger, and H. Schmidt May 1969 19 p refs Presented at the Conf. on Computer Systems in Exptl. Nucl. Phys., Skytop, Pa.
(KFK-982; CONF-690301-6) Avail: CFSTI

Characteristic features of two on-line systems, namely a coupled CDC 160 A-8090 computer system called MIDAS and a CDC 3100 system, are described. MIDAS in its present version is a data acquisition and reduction system allowing on-line accumulation and totalizing of 256 K channels on a disk and sequential accumulation on magnetic tape. This system is shared by up to 10 experiments. For a typical 3-parameter experiment the handling of data will be discussed. The CDC 3100 is used for cyclotron experiments. For this computer a program controlled direct memory access for time-of-flight measurements has been built. It allows 15K totalizing with 100 K cycle input rate. Electronical drifts are automatically controlled and corrected. For 4 parameter (n,x)-experiments in the neutron energy range 0.5 – 30 MeV with typical counting rates of 300 Hz the computer identifies secondary particles reducing the number of words to be stored. Author (NSA)

N70-20907# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTING SYSTEMS: SELECTED ARTICLES
A. A. Koifman et al 28 May 1969 51 p refs Transl. into ENGLISH from Vychislitelnye Sistemy (Moscow), no. 26, 1967 p 3-24, 45-56, and 121-129
(AD-696170; FTD-MT-24-95-69) Avail: CFSTI CSCL 9/2

Contents: Programming for a two-dimensional computing medium; About one variant of a combined computer system; and A cryotron element of a computing medium built on the double logic principle. TAB

N70-20916# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIGITAL COMPUTER TECHNOLOGY AND PROGRAMMING (SELECTED ARTICLES)
G. G. Ovsyannikov et al 6 May 1969 39 p refs Transl. into ENGLISH from Tsifrovaya Vychislitelnaya Tekhn. Programmirovanie (USSR), no. 3, 1967 p 94-111
(AD-695915; FTD-MT-24-88-69) Avail: CFSTI

Contents: A method of collecting statistical data on the reliability of magnetic tapes; and some results on the collection and processing of statistical data on magnetic tape errors. TAB

N70-20917# RAND Corp, Santa Monica, Calif.
LOGICAL ASPECTS OF QUESTION-ANSWERING BY COMPUTER
J. L. Kuhns Dec. 1969 33 p refs Presented at 3d Intern. Symp. on Computer and Inform Sci., Miami Beach, Fla., 18-20 Dec. 1969
(AD-698185; p-4251) Avail: CFSTI CSCL 5/2

The paper discusses the problem of computerized question-answering from the point of view of certain technical, although elementary, notions of logic. Although the work reported herein has general application to the design of information systems, it is specifically motivated by the RAND Relational Data File. This system, for which a prototype has been implemented, deals with the retrieval and processing of information from a large file of relational sentences. The report does not discuss specific details of the system but rather an abstract version of it. The purpose is to demonstrate how notions in logic can be used to influence the design of components of an information system. A secondary purpose is to show how logic can be applied to the analysis of natural-language. Author (TAB)

N70-20941# Computer Symbolic, Inc., Washington, D.C.
DEVELOPMENT OF A MACHINE-INDEPENDENT, MULTI-LEVEL, RECURSIVE MACRO SUBSTITUTION LANGUAGE FOR THE SPECIFICATION OF REAL FILE STRUCTURES AND THEIR OPERATIONAL ENVIRONMENTS Final Report
Kenneth B. Krohn 20 Nov. 1969 46 p refs
(Contract F44620-69-C-0020)
(AD-697826; AFOSR-69-2993TR) Avail: CFSTI CSCL 9/2

The report describes a machine-independent, multi-level, recursive macro-substitution language, called mini-FIRMS, that can be used as a vehicle in the mathematical simulation of machine filing structures. This language is intended to enable the evaluation and optimization of memory structure and function in applications to the filing of information. In particular, it will assist in the construction of efficient representations for data bases in existing machine filing structures as well as provide criteria for the specification of a repertory of schematic data bases for use in analyzing the efficiency of practical filing configurations. The language is also the foundation for a general programming system, to be developed, that it is hoped, will provide significant advantages in the construction of compilers, time-sharing systems, and other non-functional software as well as of filing systems. The memory structure optimization features of this system are designed to be particularly useful in the creation of efficiently running hardware-independent software. Author (TAB)

N70-20969# Akademiya Nauk URSR, Kiev.
ON THE QUESTION OF CLASSIFYING ANALOG/CODE CONVERTERS
E. I. Pavlyuk and V. A. Pognibnoy *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 131 – 134 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Analog converters are now classified into two broad categories: (1) the comparator type with differential sensing and closed circuitry, usually with an inverse conversion from code back to analog, and (2) the type which uses conversion directly and is characterized by an open circuit, with sequential or cumulative counting, and direct coding. Each of these converters can be further subdivided into those of servo or followup action and those of cyclic action. A third classification of analog to code converters is proposed, which combines characteristics of the first two types. This classification, which also can be further broken down into followup or cyclic action type converters, will be known as analog to code converters of the combined conversion type. B.E.S.

N70-20970# Akademiya Nauk URSR, Kiev.
MEMORY ELEMENTS WITH MODULATED RELUCTANCE
A. Ye. Ashman *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 135 – 146 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A general review is made of magnetic core memory elements for use in digital automation and computer applications where nondestructive readout capability is required. The general type of element considered is a three-aperture core of various configurations similar to a transfluxer core. The technique for storage and readout of information from such core systems is reviewed and examples of three-aperture core elements are briefly described. Those mentioned are manganese ferrite cores with an internal diameter of 4.4mm, requiring recording currents of 350 ma, a read current of 450 to 500 ma, a core switching time of 1 to 1.5 microseconds, an interrogation frequency up to 5 MHz, and an operating temperature range from –60 to +125 C. B.E.S.

N70-20999 National Lending Library for Science and Technology, Boston Spa (England).
THE HANDLING OF AUTOMATIC DATA IN GAS CHROMATOGRAPHY
J. Baudisch 21 Nov. 1969 7 p refs Transl. into ENGLISH from Chromatog., v. 1, 1968 p 443 – 445

(NLL-NSTIC-Trans-2189-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Eng.: .1 NLL photocopy coupons

The increasing demands for accuracy and reliability of analytical data as well as the necessity, brought about by increasing wage costs, of rationalizing laboratory work, led to the idea of using computer-controlled data-handling equipment in gas chromatography. The tasks involved in the basic construction and principle of operation, and the advantages and disadvantages of using a computer as central unit are described. Author

N70-21050# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

FULL AFLs AND NESTED ITERATED SUBSTITUTION

Sheila A. Greibach Aug. 1969 42 p refs

(Contract F19628-68-C-0029)

(AD-697426; AFCRL-69-0333; SR-1) Avail: CFSTI CSCL 5/7

Recently there have been several investigations of the closure under substitution of various families of languages, and of the relation of substitution to AFLs in general. A machine realization of the substitution closure of a full AFL I was obtained by finitely nesting tapes of any machine representation for I. It was shown that if any full AFL I is not closed under substitution, the result of substituting members of I into I, is not substitution closed and hence I generates an infinite hierarchy of full AFLs and the substitution closure of I is not full principal. In the paper we define a generalization of the substitution operator, called nested interated substitution, examine the properties of families of languages closed under nested iterated substitution, establish the appropriate machine characterization and discuss related decision problems. TAB

N70-21089# Army Foreign Science and Technology Center, Washington, D.C.

RESEARCH ON THE APPLICATION OF DIGITAL AND ANALOG COMPUTERS IN NUCLEAR PHYSICS AND ENGINEERING (COLLECTED ARTICLES)

A. P. Klarin et al [1967] 128 p refs Transl. into ENGLISH from a Russian Report, 1967

(AD-692628; FSTC-HT-23-397-68) Avail: CFSTI CSCL 20/8

Twelve papers are presented on the following topics: (1) immediate access buffer for processing physics experimental data; (2) immediate access buffer circuitry; (3) magnetic tape accumulators for data storage; (4) physics data reduction problems; (5) immediate access accumulator reliability; (6) thoristor effect on data recording time in analyzer memory; (7) thoristorized buffer feasibility; (8) cyclical memory structures for recording physics data; (9) procedures for using analog computers for controlling a linear electron accelerator; (10) modeling linear accelerator operating characteristics with analog computers; (11) analog computer analysis of charged particle motion dynamics in a linear accelerator; and (12) function converter design for analog computers used in modeling linear accelerator characteristics. E.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-19747# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Inst.

DETERMINATION OF THE BASIC ELECTRICAL AND ENERGY PARAMETERS OF A TOROIDAL SOLENOID [OPREDELENIE OSNOVNYKH ELEKTRICHESKIKH I ENERGETICHESKIKH PARAMETROV TOROIDAL'NOGO SOLENOIDA]

P. I. Melikhov 1968 24 p refs In RUSSIAN

(IAE-1615) Avail: CFSTI

The principal electrical and energy parameters of a toroidal solenoid are determined for two variants of a design execution of winding sections (with constant and linearly varying thicknesses). Simple analytical dependences were obtained for those parameters with an error of not more than + or - 7%. Graphs are presented which permit, on the basis of the given size of the magnetic field on the solenoid axis and the geometric characteristics, determining the unknown values of its parameters. The error of the graphs does not exceed + or - 10%. NSA

N70-19844*# North American Rockwell Corp., Anaheim, Calif. Autonetics Div.

INVESTIGATION OF MULTILAYER PRINTED CIRCUIT BOARD MATERIALS Final Report

J. E. Meinhard Oct. 1969 67 p refs

(Contract NAS8-21477)

(NASA-CR-102482) Avail: CFSTI CSCL 09A

A concept is described to reduce the present process liabilities by developing a three-dimensional circuit technology which employs materials of greater compatibility. It consists of substituting organic conductors for copper conductors, at least in the z-direction, and unfilled organic polyimide for the glass-epoxy dielectric. Feasibility of the essential process steps was demonstrated, and significant progress was made in providing an appropriate organic conductor. The polyimide dielectric, in addition to achieving a higher thermal expansion compatibility, even with metallic conductors, showed unusual tractability in process techniques and a superior stability toward physical degradations of all types. Full advantage of these properties was taken to eliminate a variety of additional reliability problems, such as board drilling, delamination, corrosive residues and pattern misregistration. The materials and techniques required to obtain these results are described in detail. Author

N70-19916*# Radiation, Inc., Melbourne, Fla. Microelectronics Div.

CUSTOM METALLIZED MULTIGATE ARRAY, SECTION 2 Interim Technical Report

26 Jan. 1970 60 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952592)

(NASA-CR-108264) Avail: CFSTI CSCL 09A

Alternate reliability concepts for a custom metallized multigate array are discussed. Since the 10-year lifetime goals for the product make conventional screening and burn-in procedures unacceptable, unconventional avenues were explored. The study included a literature search and brainstorming sessions with device and circuit engineering specialists. The basic idea is to use test patterns as process quality evaluation tools. These patterns used in conjunction with revised inspection procedures offer adequate means to accomplish the goals. Author

N70-19917*# Radiation, Inc., Melbourne, Fla. Microelectronics Div.

CUSTOM METALLIZED MULTIGATE ARRAY, SECTION 1 Interim Technical Report

26 Jan. 1970 154 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952592)

(NASA-CR-108768) Avail: CFSTI CSCL 09A

The proposed design approach to the CMMA involves the following: (1) Fabrication of an array of 92 three-input, open-collector NAND gates; 24 three-input, active pull-up NAND gates; and 24 three-input extender and resistor pull-up cells. (2) Fabrication of this array through a minimum complexity, high packing density epitaxial base process. (3) Component interconnection and custom gate interconnection through use of a two-level aluminum-silicon dioxide-aluminum metallization system and a diffused power and ground distribution system. Results include the

following: (1) optimization of the epitaxial base process for the CMMA application and fabrication and characterization of devices suitable for application in the multigate array; (2) design and analysis of circuit structures required for mechanization; and (3) performance of process verification and reliability studies on the two-level metallization system. Author

N70-19929*# Stanford Research Inst., Menlo Park, Calif.
MTRAC: A COMPUTER PROGRAM FOR ANALYSIS OF CIRCUITS INCLUDING MAGNETIC CORES. VOLUME 1: COMPUTATION, PROGRAM, AND APPLICATION Final Report
D. Nitzan and J. R. Herndon Jun. 1969 161 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951840; SRI Proj. 6408)
(NASA-CR-108250; RR-6) Avail: CFSTI CSCL 09A

The method of computation, the orgsnization, and applications of the Modified Transient Radiation Analysis by Computer program are described. The computation is iterative, and based on the current though any circuit element connected between two nodes a and b as i sub ab = delta H(V sub a − V sub b) − delta T, where delta H and delta T are constants, and by applying this relation to every circuit node, a matrix equation for this relation is developed at every node. The program consists of two sections, initialization, and the transient solution. The tasks performed by each section are analyzed. F.O.S.

N70-19930*# Stanford Research Inst., Menlo Park, Calif.
MTRAC: A COMPUTER PROGRAM FOR ANALYSIS OF CIRCUITS INCLUDING MAGNETIC CORES. VOLUME 2: INPUT DATA AND PROGRAM LISTING
D. Nitzan and J. R. Herndon Jun. 1969 194 p Prepared for JPL
(Contracts NAS7-100; JPL-951840)
(NASA-CR-108766; Rept-6) Avail: CFSTI CSCL 09A

The instructions for the input-data cards, glossary of variables, and the listing of the modified transient Radiation Analysis by Computer program are provided. Author

N70-19956# Innsbruck Univ. (Austria).
CONSIDERATIONS ON THE DIMENSIONING OF FERRITE ANTENNA AMPLIFIERS IN THE VLF REGION Scientific Report, Feb. –Mar. 1969
Norbert Nessler 15 Jul. 1969 39 p refs
(Contract F61052-69-C-0007)
(AD-695489; AFCRL-69-0420; SR-2) Avail: CFSTI CSCL 9/5

For the reception of VLF waves, ferrite rod antennas are used which are usually coupled with the preamplifier input via a transducer. Relations are derived which permit the optimum dimensioning of antenna inductance and transducer in order to attain as high a signal voltage as possible. The noise behavior of the input stage is taken into consideration in a suitable adaptation. Author (TAB)

N70-19992# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
THE APPLICATION OF ADVANCED INTEGRATED CIRCUIT TECHNIQUES TO RADAR AND SENSOR DATA HANDLING
Howard H. Steenbergen and Lutz J. Micheel *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 323–327
(See N70-19968 08-07)
Avail: CFSTI

Large scale integrated circuit arrays described require maximum control to insure stability and reliability of the monolithic dies. By placing most of the first level system interconnections on the die, the ratio of bonds per gate function, and thus the total number of bonds is drastically reduced to the reliability increased. For high speed memories complementary metal-oxide semiconductors have been developed that provide 1000 nanosecond cycle times and nanowatt stand-by power per bit. Very low current, high gain transistors, compatible MOS and thin-film resistors, and forward techniques gave a microwatt emitter-coupled logic for applications in medium speed, portable digital equipment. A new silicon device, consisting of a fixed and a nonlinear resistor, is described and its application in analog processing functions previously accomplished with electromechanical devices is projected. G.G.

N70-20014# Army Foreign Science and Technology Center, Washington, D.C.
CYCLOTRON-TYPE MILLIMETER BAND AMPLIFIER
I. A. Antakov et al 19 Nov. 1969 8 p Transl. into ENGLISH from Soviet Patent no. 224713 (27 Sep. 1969)
(AD-698167; FSTC-HT-23-197-70) Avail: CFSTI CSCL 9/5

The invention pertains to the class of ultrahigh frequency electrovacuum devices. The proposed amplifier makes it possible to eliminate the self-excitation and to increase the gain. This is achieved by the cross-sectional dimensions of the waveguide system smoothly (adiabatically) increasing from the middle of the wave guide to the power input and output. In this case, the intensity of the longitudinal magnetostatic field controlling the helical electron stream is smoothly reduced from the middle to the ends of the waveguide system, which is assured by a corresponding distribution of the amperaturns of the solenoid. This condition in particular is satisfied by a distribution of the solenoid field with a uniform density of the ampere turns at a specific ratio of the length of the solenoid to its diameter. Author (TAB)

N70-20069 Lehigh Univ., Bethlehem, Pa.
CHARACTERIZATION OF A SUBNANOSECOND TRANSISTOR FOR ULTRA HIGH SPEED SWITCHING CIRCUITRY
Paul Cooper Davis (Ph.D. Thesis) 1968 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 69-7330

A model was developed from doping profiles and material information which will predict dc and switching performance of a subnanosecond transistor. The transistor is modelled for device design using Linvill elements which relate excess minority carrier density to current. Accurate impurity density profiles are required for this purpose and two methods to obtain them are described. The transit times obtained were compared with those calculated using the model derived from doping profiles. The validity of the base widening theory was substantiated by measuring transit times for a range of collector-base voltages and emitter currents. The calculated circuit voltage vs. time waveshapes were within 10 percent of the experimental waveshapes. This substantiates the theoretical model and demonstrates that doping-profile models developed for subnanosecond transistors are able to predict with reasonable accuracy switching performance in practical circuits. Dissert. Abstr.

N70-20130 Yale Univ., New Haven, Conn.
A NEW ANALYSIS OF THE FIELD EFFECT TRANSISTOR
Frank Arthur Regier (Ph.D. Thesis) 1968 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-8416

The objective of this research was to provide a more detailed understanding of FET behavior below pinch-off through an improved picture of the potential distribution in an FET. To this end, the gradual channel approximation was removed, and the analysis of the FET was handled as a boundary value problem. A symmetrical FET model, based on measurements of a specific device, is proposed. The FET half model is divided into two regions separated by an interface whose location it is necessary to determine as part of the problem. A suitable set of boundary conditions is proposed for both the external boundary and the interface. In the absence of a rigorous uniqueness proof a heuristic uniqueness argument is

given. The boundary value problem was solved numerically with the aid of an IBM 7094 computer, and potential distribution solutions were obtained for a series of electrode voltages. These solutions do not incorporate the gradual channel approximation and represent an improvement over previous solutions. Although the reasonableness of Shockley's solution is confirmed, significant differences occur. Dissert. Abstr.

N70-20158 Rensselaer Polytechnic Inst., Troy, N.Y.
SYNTHESIS OF NONUNIFORM RC DISTRIBUTED CIRCUITS
Edward D. Walsh, Jr. (Ph.D. Thesis) 1968 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-6480

A synthesis procedure by which any RC-realizable, rational transfer function can be passively realized as the open circuit voltage transfer ratio of a RC distributed circuit is presented. The synthesis procedure was completely programmed on a digital computer. From the specification of the transfer function and of the electrical properties of the construction materials, the computer produces the geometrical dimensions for the physical construction of the distributed circuit. The synthesized distributed circuits all have a standardized topology, with only the nonuniform tapers of the circuits depending on the specified transfer function. The circuits are simple and can be readily constructed by thin film techniques. The computer program, example problems, and experimental results are included in the thesis. Dissert. Abstr.

N70-20171 California Univ., Berkeley.
SEMICONDUCTOR DEVICES AND AMPLIFIERS AT CRYOGENIC TEMPERATURES
Emanuel Elad (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-3595

The purpose of the thesis is to search for optimum semiconductor materials, devices and amplifier circuit configurations for cryogenic operation. The physical properties of semiconductor materials at low temperatures are necessarily of prime importance and those of germanium, silicon, GaAs and InSb are described specifically. The high-mobility III - V compounds are particularly promising for cryogenic operation, but their technology is still behind that of elemental semiconductors. Special attention is given to typical cryogenic effects such as carrier freeze-out, impact ionization and high carrier mobilities. Semiconductor devices based on majority carrier conduction, such as the field-effect transistors, are more suitable for cryogenic operation because of their increased mobilities and conductivities, while minority carrier devices are hampered by the decrease of carrier lifetime and carrier freeze-out. Dissert. Abstr.

N70-20208 Syracuse Univ., N.Y.
TWO-DIMENSIONAL SCATTERING AND RADIATION FROM PERFECTLY CONDUCTING CYLINDERS OF ARBITRARY SHAPE
Robert Fredrick Wallenberg (Ph.D. Thesis) 1968 139 p
Avail: Univ. Microfilms: HC $6.60/ Microfilm $3.00 Order No. 69-7788

A unified analysis of the problem of two-dimensional scattering and radiation from a perfectly conducting cylinder of arbitrary shape is presented. Integral equation formulations are given for both transverse magnetic (TM) and transverse electric (TE) polarizations. Two new TE formulations are presented, one based on computing the electric field due to equivalent magnetic surface currents, and the other based on the retarded scalar and vector potential integral formulas. The solution is described in terms of the method of moments, by which the integral equations are reduced to matrix equations. The solution is basically one which treats the cylinder as a collection of current elements, and expresses the interaction between every pair of elements by an impedance matrix. The excitation of the cylinder is due to an impressed electric field, which is represented by a voltage matrix. Dissert. Abstr.

N70-20257# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.
ATTENUATOR BASED ON A FERRITE RESONANCE SWITCH [ATTENYUATOR NA OSNOVE FERRITOVOGO REZONANSNOGO VENTILYA]
L. E. Tsopp 1968 8 p refs Transl. into ENGLISH from Akad. Nauk SSSR Inst. Fiz. (Moscow), Rept. NP-17759, 1968 p 1-7
(AEC-tr-7067; NP-17759) Avail: CFSTI

Theoretical concepts and experimental characteristics are given for a ferrite switch used as a dissipative plasma attenuator in the Ramus II (R-II) device. Graphical data show that by varying the intensity and direction of the magnetic field the attenuation can vary from minimum to maximum magnitudes; installation of a second switch in a waveguide circuit, adjusted to the resonance, by switching to the current in the electromagnet was capable of regulating the damping in the circuit from 0 to 45 db. It is also shown that an installation of series-connected attenuators could achieve the attenuation up to 100 db and over. NSA

N70-20306# Lincoln Lab., Mass Inst. of Tech., Lexington.
AUTOMATIC MICROWAVE CIRCUIT ANALYSIS WITH GCP-MOD2
William J. Getsinger and Thomas E. Maggiacomo 10 Jul. 1969 45 p refs
(Contract AF 19(628)-5167)
(AD-697954; TN-1969-34; ESD-TR-69-204) Avail: CFSTI CSCL 9/5

GCP-MOD2 is an extremely rapid means for performing frequency analyses of equivalent circuits of cascaded two-ports. An operator describes his circuit to GCP-MOD2, using an abbreviated plain English vocabulary, and specifies measurements to be made at an appropriate terminal plane for frequencies of interest. GCP communicates laconically with the operator as it accepts the circuit description and any other instructions. It then tabulates the results of the measurements, and awaits further instructions, such as circuit modifications or different measurements. As a typical example, a microwave filter circuit, made up of lengths of transmission line and five resonators, of both lumped and distributed elements, can be described to GCP and evaluated at a dozen frequencies for such measurements as insertion loss, transmission phase-shift, and input impedance, all in about 10 minutes. Author (TAB)

N70-20459# Army Foreign Science and Technology Center, Washington, D.C.
LOW-POWER ELECTRONIC TUBES TYPE 30TS6S FOR A BROAD RANGE OF APPLICATIONS
10 Nov. 1969 13 p ref Transl. into ENGLISH from the Russian
(AD-698165; FSTC-HT-23-303-69) Avail: CFSTI CSCL 9/1

The article outlines specifications for testing low-power electronic tubes of type 30Ts6S. Testing specifications for vibration, heat-stability, humidity-stability are included. Tests for short circuiting, breakdown, and guaranty of durability are shown as well. There are details of requirements for testing under various heat conditions. More details of vibration testing are also included. Author (TAB)

N70-20466*# Virginia Univ., Charlottesville. Div. of Electrical Engineering.
INVESTIGATION OF THE DETECTIVITY OF RADIATION-PRODUCED DEFECT LEVELS IN n AND p-TYPE SILICON AND GERMANIUM Semiannual Progress Report
Robert J. Mattauch March 1969 35 p refs
(Grant NGR-47-005-093)
(NASA-CR-66884; EE-4031-102-69U) Avail: CFSTI CSCL 09A

Black body data were collected on devices of n-type silicon with resistivities of 1, 0.1, and .03 ohm-cm and of p-type silicon with resistivities of 0.1, 1, and 10 ohm-cm. The current-voltage characteristics of the p-type devices were found to be slightly nonlinear with the Ni contacts presently used at liquid nitrogen temperatures. One ohm-cm n-type devices whose liquid nitrogen temperature resistances varied from 5.0 × 10 to the 7th power to 3.5 × 10 to the 10th power ohms were examined. The effects of annealing such devices were examined, and definite trends were found for the effect of frequency of incident radiation, of bias voltage across the device, and of annealing on the black body responsivity. A spectral system gives a source of monochromatic electromagnetic radiation variable from 1 to 20 microns by utilizing four different diffraction gratings. The peak spectral response is in the 1 – 4 micron region. This information and that obtained by the use of windows of various spectral transmission allow the establishment of the wavelength range of operation of the detector. A computer program was perfected which will yield a plot of spectral detectivity as a function of wavelength. Author

N70-20516# Bradford Univ. (England). Postgraduate School and Electronic Engineering.
INTERMODULATION PHENOMENA IN THE RING MODULATOR
J. G. Gardiner May 1969 14 p refs
(Rept-20) Avail: CFSTI

Investigations into the intermodulation distortion performance of ring switching modulators indicate that under some conditions superior performance is observed to that predicted by current theory. A modification to the analytical model of the diode is proposed which permits prediction of these apparently anomalous results. Author

N70-20569# Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
DISTORTION REJECTION IN SQUARE-LAW DIODE MIXERS
J. G. Gardiner Apr. 1969 17 p refs
(Rept-19) Avail: CFSTI

It is shown that third order intermodulation distortion is produced by an ideal square-law diode working between tuned terminations and that complete rejection of distortion requires the existance of higher order terms than V squared in the diode current-voltage characteristic. Suitable higher order terms are obtained at particular drive levels in conventional diodes and Schottky barrier diodes but not in the space charge limited diode. Author

N70-20691# Wisconsin Univ., Madison. Electrical Engineering Dept.
NEURISTOR PROPAGATION ANALYSIS
R. D. Parmentier [1969] 46 p refs Sponsored by NSF
Avail: Issuing Activity

A neuristor model is described by a set of nonlinear partial differential equations in one spatial dimension and time. Physically, a neuristor pulse waveform is one that propagates at constant velocity with a fixed waveshape; mathematically, such a waveshape reduces the partial differential equations to ordinary differential equations which are then solved using either phase space topology analysis or computer techniques. The stability of neuristor pulse waveforms may be studied using either eigenfunction expansion of the perturbation equations or Lyapunov stability theory. This latter tool also provides estimates of the excitation threshold for launching a neuristor pulse. Determining the nature of pulse interactions on a neuristor, which specifies the refractory behavior of the neuristor, may in some cases be accomplished using analytic or perturbation series techniques, but in general requires computer solution of the partial differential equations. Author

N70-20694*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
BROADBAND MODIFIED TURNSTILE ANTENNA Patent Application
Paul H. Lemson, inventor (to NASA) Filed 1 Dec. 1969 13 p
(NASA-Case-MSC-12209-1; US-Patent-Appl-SN-881039) Avail: CFSTI CSCL 09E

An antenna element is provided with two resonant half-wave dipoles energized through feeders connected to the dipoles with a delta match. The feeders to each dipole cooperate with the dipoles and each other to form a half-wave wire slot. Two antenna elements may be combined and fed in phase quadrature to develop circular polarization. NASA

N70-20723*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE dc MOTOR SPEED CONTROL SYSTEM Patent Application
William M. Mc Campbell and Hershel M. Nance, inventors (to NASA) Filed 16 Dec. 1969 12 p
(NASA-Case-MFS-14610; US-Patent-Appl-SN-885571) Avail: CFSTI CSCL 09C

A motor speed control circuit wherein a signal proportional to the IR drop of the armature is utilized to drive a self excited inverter to obtain a feedback voltage equal to the IR drop of the armature. The feedback voltage is added as a positive feedback to a constant dc voltage to form the input to a unity gain amplifier. The last stage of the amplifier is in series with the armature of the motor. The speed at which the motor operates is controllable by means of varying the value of the constant dc voltage. NASA

N70-20726*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RF CONTROLLED SOLID STATE SWITCH Patent Application
Thomas B. Fryer, inventor (to NASA) Filed 9 Oct. 1969 21 p
(NASA-Case-ARC-10136-1; US-Patent-Appl-SN-865106) Avail: CFSTI CSCL 09F

An electronic element, capable of presenting either a high impedance or a low impedance between a power source and an instrument, is switched from its high impedance to its low impedance state by turning on both active elements of a complementary bistable multivibrator. By momentarily short-circuiting one of the two active elements of the complementary bistable multivibrator, thereby driving its two active elements from the on to the off state, the electronic element is switched back from its low impedance to its high impedance state. When off, this circuit consumes essentially zero standby power. Alternative switching circuits use symmetrical bistable multivibrators, activated by amplified and rectified transmitted pulses, to switch a gating element from its high impedance to its low impedance state, and vice versa. NASA

N70-20734*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SERIES VOLTAGE REGULATOR Patent Appl.
Sherwood Thaler, inventor (to NASA) Filed 13 Oct. 1969 14 p
(NASA-Case-ERC-10113; US-Patent-Appl-SN-865811) Avail: CFSTI CSCL 09E

Voltage regulators designed for connection in series with an alternating current source and a load and employing a three-leg, two-window transformer are described. Secondary windings on the two outer transformer core legs are interconnected to form a pair of secondary winding systems and the systems are interconnected via a variable resistance. Voltage regulation is achieved by varying the flux distribution in the transformer core by means of employing the variable resistance to distribute the load current between the winding systems. NASA

N70-20737*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRICAL CONNECTOR Patent Application
Bobby W. Kennedy, inventor (to NASA) Filed 26 Nov. 1969 15 p
(NASA-Case-MFS-14741; US-Patent-Appl-SN-880247) Avail: CFSTI CSCL 09A

A rectangular-shaped connector for flat conductor cables includes a pair of elongated rectangular insulating blocks having pin and socket contacts disposed in opposing spaced apertures. The blocks are encased by mating, flat-faced housings through which the cable conductors extend, the exposed ends of insulated conductors being joined to the contacts. Housing ends are enclosed by potting boots sealed to the conductor insulation. Hermetic sealing and avoidance of arcing are realized by filling void spaced with a potting material, in particular, CNR resin for service under extreme conditions, and by providing a seal of such material between the housings. NASA

N70-20738*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A CIRCULARLY POLARIZED ANTENNA
Lester C. Van Atta and Robert J. Mailloux, inventors (to NASA) Filed 6 Oct. 1969 23 p
(NASA-Case-ERC-10214; US-Patent-Appl-SN-863914) Avail: CFSTI CSCL 09E

Two sets of linearly polarized antenna elements (slots or dipoles) are arrayed in similar patterns in two planes, the first set being orthogonal to the second set. The first set is driven in phase quadrature with respect to the second set, resulting in a circularly polarized antenna beam being formed. NASA

N70-20739*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BUCK-BOOST dc VOLTAGE REGULATOR Patent Application
Thomas Anthony La Vigna, inventor (to NASA) Filed 6 Oct. 1969 29 p
(NASA-Case-GSC-10735-1; US-Patent-Appl-SN-863983) Avail: CFSTI CSCL 09E

A buck-boost voltage regulator is described wherein the output of a dc voltage source to be controlled is combined with a source of alternating current from an inverter. The resultant signal is applied to a chopper circuit. The chopper circuit utilizes a pair of switching transistors alternately maintained in conduction by a single current transformer and an inductive load. The chopper circuit is designed to permit instantaneous switching between the transistors and is further designed to prevent simultaneous conduction thereof. This allows operation of the chopper circuit through a wide range of frequencies without any long commutation intervals and thereby prevents short circuits from being applied through the transformer to the inverter. NASA

N70-20742*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
LEAD ATTACHMENT TO HIGH TEMPERATURE DEVICES Patent Application
Richard Farrell, inventor (to NASA) Filed 23 Oct. 1969 16 p
(NASA-Case-ERC-10224; US-Patent-Appl-SN-868775) Avail: CFSTI CSCL 09A

A technique is discussed for the attachment of leads to electronic devices which permits operation of the devices over a wide temperature range. The technique contemplates the use of core conductors having a thin coating of metal on which only a limited amount of coating material is available to form an alloy which bonds the core conductor to the device electrode, the electrode composition thus being affected only in the region adjacent to the lead and the bond between the electrode and device being unaffected. NASA

N70-20831# International Business Machines Corp., Yorktown Heights, N.Y. IBM Watson Research Center.
SCHOTTKY-BARRIER TRANSISTOR Final Report, 17 Dec. 1968-19 Aug. 1969
Karsten E. Drangeid Aug. 1969 48 p refs
(Contract F19628-68-C-0343)
(AD-697819; AFCRL-69-0376) Avail: CFSTI CSCL 9/1

The purpose of the work was to design and realize Schottky-barrier field-effect transistors with high channel doping. In the first chapter the microwave properties of the transistors are reported and the measurement techniques are described. The second chapter treats the investigation of the breakdown voltage of the Schottky contact on Si. Transistors realized by another technology using gold instead of Cr-Ni Schottky barriers have shown a higher breakdown voltage. This technology is described in the third chapter. Channels with high doping have small breakdown voltages therefore very thin channel thicknesses have to be used. For such thin channels the carrier concentration cannot be considered to be constant due to the fact that the thickness of the channel is comparable with the Debye length and also the donor concentration is not constant. This investigation is described in the fourth chapter. The fifth chapter describes the work performed on the GaAs transistors. Author (TAB)

N70-20951# Akademiya Nauk URSR, Kiev.
QUESTIONS ON THE THEORY OF ELECTRIC CIRCUITS FOR CONVERSION OF MEASURING INFORMATION
1967 171 p refs In RUSSIAN
Avail: CFSTI

Papers are presented on electric circuit theory and calculations. Emphasis is placed on data converter circuits with contactless semiconductors and magnetic elements having good reliability and long service life. For individual abstracts see N70-20952 through N70-20974.

N70-20953# Akademiya Nauk URSR, Kiev.
EFFECT OF MODULATOR NOISE ON THE NULL STABILITY OF A SIGNAL TRANSMISSION MEASURING TRANSDUCER WITH CARRIER
Ye. D. Vasilyev *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 19-25 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Using the Hill method, the degree of null shift is determined with relation to the magnitude of modulator noise. For the case of the measuring device or transducer which contains strong negative feedback, conditions are examined under which the null shift can be deduced from an analogous magnitude of an open circuit system. Results show that, after selection of an appropriate low frequency filter, the feedback does not change the null shift value of the measuring transducer reduced at the input. B.E.S.

N70-20954# Akademiya Nauk URSR, Kiev.
FREQUENCY CONVERTOR USING A DUAL CIRCUIT PARAMETRIC OSCILLATOR
M. A. Rakov *In its* Questions on Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 26-36 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A frequency converter circuit is examined in which the controlled oscillator is formed by a dual circuit parametric system using a magnetized inductor. The converter is capable of reliable frequency conversion with various coefficients of conversion. If a multiplier device is used in place of a phase detector, it is possible in principle to develop a multistable circuit element without semiconductor triodes. A circuit of this type operating at ultrahigh or superhigh frequencies would be useful in the design of cybernetic systems. B.E.S.

N70-20955# Akademiya Nauk URSR, Kiev.
SELF-EXCITED FREQUENCY CONVERTERS OF ELECTRICAL SENSOR OUTPUT SIGNALS
Yu. P. Kravchenyuk *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 31–38 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Analog to discrete signal converters which transform input analog amplitude to a variable frequency modulation signal are discussed. Transducers with variable inductance, capacitance, and resistance are considered. In each case, the frequency converter consists of a controlled self-excited oscillator with associated frequency controlling elements. For each of the three general types, basic input signals are given and the relative sensitivity of frequency conversion is tabulated. The converters permit frequency conversion of a wide range of input signals both electric and nonelectric in control system operation. B.E.S.

N70-20956# Akademiya Nauk URSR, Kiev.
THE ac PARAMETRIC TEMPERATURE MODULATORS USING VARICAPS
Yu. P. Kravchenyuk and V. S. Maslov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 37–41 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Advantages of using parametric transducers such as the varicaps are reviewed. Varicap capacitance varies as a function of its ambient temperature, and output signals in turn vary with capacitance change; output variation may be sensed as phase, amplitude, or frequency change. Varicap materials, including Ge, Si, GaAs, GaP, and SiC, operating temperature ranges are discussed. B.E.S.

N70-20957# Akademiya Nauk URSR, Kiev.
A LINEAR APPROXIMATION OF TRANSFER CHARACTERISTICS OF A MEASURING CONVERTER
Ya. M. Kleynman and A. A. Nadel *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 42–50 In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A linear approximation method is developed which can be applied in analyzing the nonlinearity of converting devices, such as magnetic amplifiers and analog to frequency converters. The method may also be used in developing and tuning electromeasuring readout devices. B.E.S.

N70-20958# Akademiya Nauk URSR, Kiev.
ANALYZING THE EFFECT OF CORE ASYMMETRY ON NULL BEHAVIOR OF A MAGNETIC MODULATOR IN AN EXTERNAL MAGNETIC FIELD
R. Ya. Berkman and V. M. Fedotov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 58–68 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Core defects or irregularities are assessed to determine the extent of their role in generating erroneous signals from a magnetic modulator. The magnetic modulator assumed for analysis is a second harmonic type using a toroidal core. Both analytical and experimental data are given based on assumption of geometrical asymmetry in the core and asymmetry of the core magnetic property. From a ratio of core generated field to external field, curves are developed and tabulations are given of the modulator relative sensitivity to a given external field. The calculated and experimental data indicate that a better distribution of core magnetizing current would minimize the asymmetrical effect of the core end lead to reduced errors. In present core design and applications, this does not appear to be a feasible improvement. B.E.S.

N70-20961# Akademiya Nauk URSR, Kiev.
CALCULATION OF HYSTERESIS ERROR IN dc INSTRUMENT TRANSFORMERS
I. V. Petrushko and Yu. M. Shumkov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 76–83 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

The instrument error sources considered are of two general types: (1) the failure of core permeabilities to switch to their ideal null or saturation values, and (2) the hysteresis and eddy current losses which occur in switching. When used to meter transmission line DC current whose values would not normally deviate more than + or – 20% from a normal value, the first component of error greatly exceeds the second, hence the hysteresis and eddy current could be ignored. However, when using this mater in industrial applications where wide variations in DC current may occur, the contribution of hysteresis error becomes predominant. Expressions are developed for determining the hysteresis error, and a simple expression is given for defining such error in terms of circuit parameters and magnetic core material. It is shown that with increases in core magnetization, (higher measured DC current amplitude) hysteresis error decreases. The expression developed for calculating hysteresis error yields an accuracy of about 10%. B.E.S.

N70-20962# Akademiya Nauk URSR, Kiev.
ONE-STEP STATIC FERROMAGNETIC MULTIPLIER FOR ONE-AND-A-HALF TIMES FREQUENCY MULTIPLICATION
A. M. Bamdas, S. V. Shapiro, L. N. Davydova and G. Odilov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 84–88 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A brief description is given of a dual stage, triple-wound ferromagnetic multiplier, one of whose windings contains a series capacitance. For a suitable choice of capacity value and load conditions, parametric oscillations are excited by the capacitor yielding an output frequency one and a half times the excitation frequency. A formula for determining correct capacitance values is given in terms of other circuit parameters. A laboratory model of this multiplier (identified as SPCh-1.5) has an output power of 0.4 kva when operating from a 220 volt, 50 cycle line. The nominal output at 75 cycles is 500 volts, with an efficiency to a nominal load of 57%. The core and winding weights are 10 kg. each. The capacitance is 20 microfarads. Use of this multiplier is restricted due to limits in upper and lower output load ranges. B.E.S.

N70-20963# Akademiya Nauk URSR, Kiev.
A BIASED TRANSFORMER WITH AN AIR GAP SHUNT
A. M. Bamdas, S. V. Shapiro, and V. V. Chistyakov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 89–93 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

The transformer magnetic circuit consists basically of a main shunt rectangular core separated by two identical magnetic jumpers with air gap separation. A transformer schematic is given showing the input and output voltages and winding polarities. The method by which the transformer regulates input voltage and the advantages of the model are briefly described. Advantages include a decreased output weight, less waveform distortion over a wider load range, and improved structural design requiring less magnetic material. A disadvantage is that under low load or no-load conditions it is practically impossible to regulate the transformer output voltage. The model requires about 4 to 5% less structural material than an earlier model and its power losses are about 5% less. For a transformer power of 1 kva its efficiency working into a nominal load is 91% and the structural material weight is 16 kg. B.E.S.

N70-20964# Akademiya Nauk URSR, Kiev.
PROPERTIES OF HIGH FREQUENCY STATIC FERROMAGNETIC FREQUENCY CONVERTERS WITH FERRITE CORES
V. Ye. Myasoyedov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 94–98 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A single stage multiplier is described for which the basic circuit is a frequency doubler. The cores are made of zinc manganese and are toroidal in shape. The basic doubler operates in a power range of 30 to 200 watts. Tests were held at input frequencies of 400, 1,000, and 2,500 Hz. The output characteristics of the doubler frequency were recorded as functions of variations in input frequency and power supply, and magnetic bias. Because of the low core loss in this design, the multiplier efficiency is good. In doubling an input frequency of 2,500 Hz, the efficiency working into a nominal active load is about 90%. The basic doubler stages may be cascaded for higher frequency multiplication. An example is given of a frequency quadrupler whose characteristics are also discussed. In this case the quadrupled frequency converter efficiency is about 82%. The design is shown to be an improvement over an earlier frequency multiplier which used steel rather than ferrite cores. B.E.S.

N70-20965# Akademiya Nauk URSR, Kiev.
SATURABLE CHOKE WITH REVERSIBLE OUTPUT
I. V. Petrushko *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 99–102 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A method for minimizing the effect of initial current in a saturated choke is proposed and verified experimentally. Compensation is obtained by adding a third winding between the choke control and output windings. A schematic is given showing winding polarities. With the added compensating winding, it is also possible to design the circuit parameters so that the reversal of polarity in the choke input signal will also reverse output voltage polarity. For circuit tests, a saturable choke was used with permalloy cores, having 1000 turns on the input and winding cores and 1010 turns on the compensating core. For a nominal control signal of + or – 10 ma, the conversion error did not exceed 0.1%. The saturable choke circuit with the compensating winding achieved a high conversion accuracy, good null stability, and an adequate reaction time. B.E.S.

N70-20971# Akademiya Nauk URSR, Kiev.
A RELAXATION FREQUENCY CONVERTER WITH CONTROLLABLE CONVERSION COEFFICIENT
Ya. Ye. Belenkiy *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 147–154 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A variable conversion frequency circuit with a wide dynamic range of conversion is described. The technique uses a controlled oscillator and cascaded multivibrator stages based on semiconductor triodes with a common emitter. Examples of such circuits, for both frequency dividers and multipliers, are given. A desired conversion factor can be easily obtained by switching in more or less cascaded stages. Characteristics of triode circuits are examined. B.E.S.

N70-20972# Akademiya Nauk URSR, Kiev.
USING THE EFFECT OF TRANSISTOR SATURATION IN DESIGNING A SENSITIVE DISCRIMINATOR
A. A. Bragin and R. F. Fedoriv *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 155–159 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

The use of so-called sensitive discriminators designed for detection of weak pulse signals in the range of a few millivolts is reviewed. A method is presented for detection of such signals based on the effect of transistor saturation. A discriminator of this type has high stability with respect to temperature changes and other variables. A sample schematic and a detailed analysis of the discriminator function are given. The proposed discriminator design has a temperature coefficient of only 0.03 to 0.06 millivolts per degree, which agrees well with predicted theoretical values. B.E.S.

N70-21030# Akademiya Nauk URSR, Kiev.
THE SELECTION AND TRANSMISSION OF INFORMATION, NO. 17
R. L. Imas and N. K. Sytnik, eds. Naukova Dumka 1968 183 p refs In RUSSIAN
Avail: CFSTI

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13. SELECTING DESIGN PARAMETERS FOR INDUCTION MAGNETIC RECEIVERS USED IN ELECTRIC GEOPHYSICAL PROSPECTING V. A. Nichoga p 142–147 refs (See N70-21043 08-09)

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17. THE SELECTION OF PROSPECTIVE CARRIERS OF BIOMETEOROLOGICAL INFORMATION K. S. Voychishin, V. N. Mikhaylovskiy, Yu. Yu. Sikachevskiy, and V. N. Zhegar p 175–183 refs (See N70-21047 09-04)

N70-21031# Akademiya Nauk URSR, Kiev.

INVESTIGATING THE INTERFERENCE REJECTION OF LOW-FREQUENCY INDUCTIVE ELECTRIC GEOPHYSICAL PROSPECTING

V. F. Bakhmutskiy and L. Ya. Mizyuk *In its* The Selection and Transmission of Inform., No. 17 1968 p 7–30 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Random interference is considered, with the problems of interference rejection being treated on the basis of optimum reception theory, which was developed within the static theory of communication. The applicability of optimum reception theory to statistical analysis of interference rejection is discussed and experimental results based on this theory out outlined. Transl. by R.B.

N70-21032# Akademiya Nauk URSR, Kiev.

SOME GENERAL PRINCIPLES FOR CONSTRUCTING CIRCUITS TO MEASURE THE INVARIANTS OF A MAGNETIC FIELD

V. M. Podzharyy *In its* The Selection and Transmission of Inform., No. 17 1968 p 31–41 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Various methods are studied for measuring the intensity of an elliptically polarized low-frequency magnetic field for application in inductive electric geophysical prospecting for the case of arbitrary orientation of the magnetic receivers. When maximum mobility, simplicity, and reliability of the equipment are required, a measuring circuit is used which computes the semiaxes of projecting the polarization ellipse onto the plane of the profile under study. With the same modifications, in which the polarization ellipse plane is considerably different from the plane of the profile, it is best to use a circuit which calculates the input invariants of the complete ellipse. This is simplest and ensures the autonomy of the measuring device. This autonomy is not necessary in aerial electric geophysical prospecting, and the extreme method is simplest for measuring the semiaxes in the phase plane or for measuring the active and reactive components of the magnetic force vector. Transl. by H.W.

N70-21035# Akademiya Nauk URSR, Kiev.

THE SHAPE OF A NATURAL TRANSIENT RESPONSE AT THE OUTPUT OF A REAL INDUCTION MAGNETIC RECEIVER

A. A. Vakul'skiy *In its* The Selection and Transmission of Inform., No. 17 1968 p 68–80 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

The problems of selecting the operating conditions of a real induction magnetic receiver are considered from the point of view of the frequency and time characteristics. Although the use of induction magnetic receivers in principle will not produce a constant transmission factor over a wide range of frequencies, it is possible to construct them in such a way that the distortions created by the nonuniform transmission factor are easily calculated. This is accomplished when the transmission factor is directly proportional to the frequency. Transl. by H.W.

N70-21036# Akademiya Nauk URSR, Kiev.

THE SIGNAL AT THE OUTPUT OF A REAL MAGNETIC RECEIVER IN THE TRANSIENT RESPONSE METHOD

A. A. Vakul'skiy and N. I. Nayda *In its* The Selection and Transmission of Inform., No. 17 1968 p 82–93 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Relationships are derived for calculating the shape of the voltage at the output of a real magnetic receiver, operating in either the oscillating or critical mode, when the secondary field from spherical conducting bodies acts upon it. The exponential shape of the build-up and linear fronts of primary field decay is considered. Transl. by H.W.

N70-21038# Akademiya Nauk URSR, Kiev.

THE EXTERNAL FIELD OF A SOLENOID LOOP

L. P. Dikmarova and V. Yu. Korniyenko *In its* The Selection and Transmission of Inform., No. 17 1968 p 102–109 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Equations are obtained for the magnetic field components outside an air solenoid loop and the conditions for the applicability of these equations are determined. The magnetic field components are defined in the cylindrical system of coordinates, the axis of which coincides with that of the loop, and the origin is located at the center. Transl. by H.W.

N70-21039# Akademiya Nauk URSR, Kiev.

INVESTIGATING INDUCTION DEVICES FOR DETECTING UNDERGROUND COMMUNICATIONS

V. F. Bakhmutskiy *In its* The Selection and Transmission of Inform., No. 17 1968 p 110–121 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

Profile curves are obtained and practical recommendations are given for selecting the optimum devices, taking into account the general specifications of search equipment. The main criterion for comparing different devices is their profile characteristics which determine the variation of the secondary induced signal in the receiver loops along the profile, perpendicular to the traverse of the cable or pipeline. Transl. by H.W.

N70-21040# Akademiya Nauk URSR, Kiev.

THE DIFFRACTION OF A PLANE ELECTROMAGNETIC WAVE ON AN IDEALLY CONDUCTING CYLINDER

V. F. Kul'ko and M. S. Mukhnova *In its* The Selection and Transmission of Inform., No. 17 1968 p 122–127 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

The solution for the case when the medium surrounding the cylinder has arbitrary electromagnetic parameters, and the product of the modulus of the wave coefficient of the medium and the cylinder radius is sufficiently large, is a generalization of known solutions of a similar problem for cases of a complex wave coefficient and a large modulus of the wave coefficient. The length of the wave falling onto the cylinder is considerably less than the diameter of the cylinder. Solution of the indicated problem is applicable to electric geophysical prospecting for minerals. Transl. by R.B.

N70-21041# Akademiya Nauk URSR, Kiev.

CALCULATING THE SYSTEMATIC ERROR IN A DIFFERENTIAL INDUCTION DEVICE

Ye. I. Boyko *In its* The Selection and Transmission of Inform., No. 17 1968 p 128–133 refs In RUSSIAN (See N70-21030 08-09)

Avail: CFSTI

The systematic error is caused by a disruption in the geometry of the device during its operation. The effect of inductive coupling between the loops is studied. It is shown that errors caused by displacing one of the loops from the compensation position by 0.05 mm and by angular deviation of one second for the given parameters of the device exceed the admissable level of compensation. Maximum rigidity of the system can be obtained when the mutual displacements of the loops are minimized or eliminated, if the space between the loops and the chassis of the device are filled with a special compound. Transl. by H.W.

N70-21042# Akademiya Nauk URSR, Kiev.
THE EFFECT OF CERTAIN DESTABILIZING FACTORS ON THE COMPENSATION LEVEL OF A DIFFERENTIAL INDUCTION DEVICE
Ye. I. Boyko *In its* The Selection and Transmission of Inform., No. 17 1968 p 134–141 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

An evaluation is given for the phase error, created by the instability in the natural parameters of the magnetic receivers of a differential induction device with integrated generating and receiving loops. Requirements are formulated for the circuit of the compensating device. Several compensator circuits are studied. Transl. by H.W.

N70-21043# Akademiya Nauk URSR, Kiev.
SELECTING DESIGN PARAMETERS FOR INDUCTION MAGNETIC RECEIVERS USED IN ELECTRIC GEOPHYSICAL PROSPECTING
V. A. Nichoga *In its* The Selection and Transmission of Inform., No. 17 1968 p 142–147 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

The optimum number of windings, the diameter of the conductor, and the inductivity and Q-factor of the coil are evaluated with respect to designing an induction magnetic receiver. Increasing the relative length of the core increases the sensitivity. The larger the value for core permeability, the lower the operating frequency, but the sensitivity increases. An increase in the weight of the receiver increases its sensitivity. It is difficult to obtain a matching of the receiver to the load at several frequencies simultaneously; therefore, complete matching will occur only at that frequency for which the inductive magnetic receiver was designed. Transl. by H.W.

N70-21044# Akademiya Nauk URSR, Kiev.
POSSIBILITIES OF APPRECIABLY INCREASING THE EXCITATION FREQUENCY OF MAGNETIC MODULATORS
R. Ya. Berkman and B. L. Bondaruk *In its* The Selection and Transmission of Inform., No. 17 1968 p 148–155 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

It is shown that the excitation frequency of magnetic modulators can be increased by a factor of 1.5 in comparison to existing data. Computational relationships are given and the parameters of the measuring amplifier are presented. The basic limiting factor for the selection of the frequency is the heating of the core, caused by the losses to magnetic reversal. An appreciable increase in frequency is achieved only in an excitation mode close to the given voltage, at which the maximum excitation current is ensured after core saturation. Residual linear inductance must be taken into account. Permalloys for the construction of magnetic modulators are preferred to ferrites. Transl. by H.W.

N70-21048# Akademiya Nauk URSR, Kiev.
THE DYNAMIC PROPERTIES OF A BRIDGE-CORRECTING SEMICONDUCTOR dc AMPLIFIER
Yu. N. Bobkov, V. G. Zubov, and D. A. Yurkovskiy *In its* The Selection and Transmission of Inform., No. 17 1968 p 165–174 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

An analysis is given of a dynamic amplifier used as the integrating unit in a measuring converter with high speed and a low level of pulsation for the output voltage. The experimental and computed transient response curves of the correcting unit are presented graphically. The analysis shows that the circuit studied is universal and that the various laws of low frequency filtration can be obtained. In this case the correcting amplifier ensures high output, and load variations do not affect its dynamic characteristics. Transl. by H.W.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-19895# Electrotechnical Lab., Tokyo (Japan).
SYSTEM ANALYSIS OF hvdc TRANSMISSION SYSTEM AND ITS DIRECT DIGITAL COMPUTER CONTROL
Noboru Ito May 1969 143 p refs In JAPANESE; ENGLISH summary *Its* Res. No. 689
Avail: CFSTI

An analysis of high voltage direct current transmission systems emphasizes: (1) suitable methods for ac-dc interconnected systems by introducing a digital computer, (2) the analytical method for multiterminal dc transmission, and (3) suitable methods for ac-dc interconnected system characteristics during balanced or unbalanced ac faults. The exploitation of digital computer control on high voltage direct current transmission is examined for applicability on complex future hybrid ac-dc systems. Author

N70-20060 Wisconsin Univ., Madison.
A UNIFIED APPROXIMATION THEORY FOR FREQUENCY SELECTIVE NETWORKS
Mike Sablatash (Ph.D. Thesis) 1968 443 p
Avail: Univ. Microfilms: HC $20.05/Microfilm $5.65 Order No. 68-16018

Detailed derivations of general characteristic functions for filters with prescribed poles, yielding Chebyshev or nearly Chebyshev behavior in the pass band(s), are presented, and necessary conditions on the residues at the poles of dw/ds are deduced. New methods for finding characteristic functions for band-pass and double pass-band crystal capacitor filters are derived, using the unified theory, and illustrative numerical examples are presented. Certain rational functions used in approximating flat delay in Chebyshev fashion are shown to be special cases of cosh w(s). General formulae are obtained for operating voltage ratios with prescribed natural frequencies and attenuation approximating a constant in Chebyshev fashion in passor stop-band(s). A number of results for these operating voltage ratios appear to be new. By suitable restriction of poles of dw/ds and residues thereat (in the cases for which these are prescribed), characteristic functions are used to obtain general formulae for even-part, odd-part and tangent-of-angle functions for one-ports. Dissert. Abstr.

N70-20108 Purdue Univ., Lafayette, Ind.
DESIGN OF OPTIMAL CONTROL SYSTEMS WITH TIME DELAY
Philipp Frederick Schweizer (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-7498

A design method is developed for systems with varying

time delays. The research is concerned with the optimality and the stability of time delayed systems. A set of necessary conditions for optimality for systems with time delay are developed. The systems considered may have time delays which are an explicit function of system state and/or the time. Computational algorithms are developed for determining the optimal control for (1) the case when the system delays are explicit functions of time and system state and the controls are unconstrained, and (2) the case when the system time delays are explicit functions of time and the controls are limited by hard constraints. Computational design procedures are presented which enable the designer to determine optimal system parameters. Stability criteria are developed for time delay systems such that satisfaction of these criteria yield definite values for the system parameters which result in an asymptotically stable response. Dissert. Abstr.

N70-20254 Purdue Univ., Lafayette, Ind.
IMPROVEMENT OF PHASE-LOCKED LOOPS BY THE INTRODUCTION OF NONLINEARITIES
Laurence Lynn Cleland (Ph.D. Thesis) 1968 121 p
Avail: Univ. Microfilm: HC $8.00/Microfilm $3.00 Order No. 69-7433

The method consists of replacing the linear loop filter with a nonlinear filter. The nonlinear operators used in constructing the nonlinear loop filter are specified in detail for first and second order phase-locked loops. Typical design criteria are used in specifying the operators. The methods apply equally well to higher order phase-locked loops once a specific set of design criteria are established. The technique is extremely simple to implement. The technique applies to all types of phase-locked loops independent of the type of phase comparator. Theoretical results and conclusions for first and second order systems are verified by experimental systems constructed on an analog computer, with the aid of a digital computer. The experimental data were found to agree very well with those predicted theoretically. Most of the results and data were derived assuming a deterministic input signal, due to the difficulty in analyzing nondeterministic signals in nonlinear systems. Since threshold is important, extensions to systems with noise are discussed, and experimental data show that the technique is still applicable. Dissert. Abstr.

N70-20333 Maryland Univ., College Park.
DELAYED INITIATION REALIZATIONS OF SEQUENTIAL MACHINES
Edward Francis Miller, Jr. (Ph.D. Thesis) 1968 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-8050

An abstract model for synchronous sequential circuits which emphasizes binary signal values and the structural characteristics of the networks is introduced. Economic and physical constraints for very high-speed digital circuits are examined, and a model for a physical circuit which correlates closely with the abstract model is presented. It is found that a class of physical networks in which synchronization is maintained by small delays in the timing-pulse circuitry offers several advantages over classical realization schemes. The properties of this class of networks (called Delayed Initiation or DI networks) are examined and it is shown that under appropriate conditions classical state-assignment theory can be applied to synthesize DI networks which behave correctly. Earlier theoretical results are then extended to DI networks which are loop-free. Arbitrary networks are then shown to be DI realizable and techniques for modification of network components which insure proper operation are presented. Dissert. Abstr.

N70-20370# Electrotechnical Lab., Tokyo (Japan).
RESEARCH ON SILENT ELECTRIC DISCHARGE AND ITS APPLICATION
Sachio Fuji and Naoshi Takemura May 1969 103 p refs In JAPANESE; ENGLISH summary *Its* Res. No. 698
Avail: CFSTI

The usefulness and applicability of both long electric arc discharge and silent electric discharge are demonstrated in industrial chemistry as in the problem of inorganic insulator deterioration. Observations on silent pulse wave form are given, and an equivalent electrical circuit of the electric discharge type and the current discharge tube are included. Investigations into the corona deterioration of polyethylene with the ozonizer type cell by physico-chemical means, and confirmation of the atomic oxygen effect on the corona deterioration of polyethylene are discussed. Design methods of electric discharge tubes are presented, and the relation between the ozone yield and electric power consumption of the ozonizer is considered to be useful for both chemical and electrical engineers. Author

N70-20411 Georgia Inst. of Tech., Atlanta.
ON THE OPTIMAL CONTROL OF DISCRETE SYSTEMS WITH BOUNDED STATE VARIABLES AND BOUNDED CONTROL VARIABLES
Joseph Samuel Boland, III (Ph.D. Thesis) 1969 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-9538

In many control theory problems it is necessary to consider the physical or imposed bounds on the control variables and state variables of the system. The computation of the optimum control for such a system usually involves the solution of a two-point boundary value problem, which is a formidable task even with present-day computers. The problem of a linear discrete-input system with a quadratic cost functional, a convex constraint on the state variables, and a magnitude constraint on the control variables is presented. The emphasis is on the development of a control algorithm that can be Ti-6Al-4V optimally control this system in real time. The convex constraint on the state variables defines a region in the state space in which the trajectory must not be allowed. With a magnitude constraint on the control variables, there may be additional regions in the state space from which a trajectory cannot be prevented from entering the original unallowable region with the control available. Dissert. Abstr.

N70-20479*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON THE OPTIMAL CONTROL OF LINEAR SYSTEMS WITH INCOMPLETE INFORMATION
Edison Tack-Shuen Tse (Ph.D. Thesis) Jan. 1970 293 p refs (GRANTS NGL-22-009-124; AF-AFOSR-68-1742; MIT Proj. DSR-71526; MIT Proj. DSR-72625)
(NASA-CR-108902; ESL-R-412) Avail: CFSTI CSCL 09C

The control of linear systems with incomplete information is considered where the unknown disturbances and/or random parameters are assumed to satisfy some statistical laws. The observer theory for linear systems is developed which generalizes the concepts due to Kalman and Luenberger pertaining to the design of linear systems which estimate the state of a linear plant on the basis of both noise-free and noisy measurements of the output variables. The separation theorem for linear system is extended for such observers-estimators. The problem of controlling a linear system with unknown gain is then considered. An open-loop-feedback-optimal control algorithm is developed which seems to be computationally feasible. Existence of such suboptimal control scheme is proved under the assumption that the uncertainties in the unknown gain will not grow in time. Convergence of such suboptimal control system to the truly optimal control system is considered. A computer program is developed to study the control of a variety third order systems with known poles but unknown zeroes. Author

N70-20614# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SYNTHESIS OF LUMPED CIRCUIT MODELS FOR

NONLINEAR INDUCTORS EXHIBITING HYSTERESIS LOOPS
L. O. Chua and K. A. Stromsmoe Jun. 1969 69 p refs
(Grant NSF GK-2988)
(TR-EE-69-20) Avail: CFSTI

A certain mathematical equation with f and g one-to-one functions is introduced as a model to represent processes characterized by dynamic hysteresis loops. Various properties of the equation are developed to show that if either x(t) or y(t) is periodic then the remaining variable becomes periodic resulting in a hysteresis loop. It is shown that the area of the hysteresis loop increases with increasing frequency and the function g determines the frequency characteristics of the equation. In the common case where the hysteresis loops are symmetric, an easy construction procedure is given to determine f and g. The differential equation is shown to have a simple circuit interpretation when it is applied to a ferromagnetic material. Two example circuits are examined to demonstrate the utility of the model. One example is a simple saturated core and the second circuit considered is a push-pull saturated core tunnel diode astable multivibrator. A special circuit model of a thin square loop magnetic core is given. Three computer simulations of the circuit model are given with the results compared qualitatively to previous papers. Author

N70-20615# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
NEGATIVE RESISTANCE AMPLIFIERS WITH PRESCRIBED TIME DELAY
G. T. Cotter and B. J. Leon Sep. 1969 102 p refs
(Grant NSF GK-2988)
(TR-EE-69-32) Avail: CFSTI

A synthesis procedure for prescribed group time delay over a finite frequency band for a certain class of active networks is presented. These networks consist of a circulator and a negative resistor in conjunction with positive R's, L's and C's. The development rests upon the judicious selection of the system transfer function. This is chosen so that not only the time delay but also the gain response is acceptable in some sense over the band. As a result, the device is more useful as an amplifier. Once the transfer function is obtained, the synthesis can immediately be implemented. For the class of systems under consideration this involves the design of a lossless ladder network terminated by a resistance. A specific synthesis procedure is outlined, and design curves obtained with the aid of a digital computer are given for both the lowpass and the bandpass cases. The time response to a pulse input in the lowpass case and to a burst of sinusoidal signal in the bandpass case is also shown. A maximally flat component can be added to the time delay in the lowpass case with no effect on the gain response by only a minor adjustment to the overall transfer function. This is accomplished by means of a constant resistance all-pass lattice network. Author

N70-20579# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
DIGITAL FILTERS
S. R. Harrison and B. J. Leon Sep. 1969 178 p refs
(Grant NSF GK-2988)
(TR-EE-69-35) Avail: CFSTI CSCL 09C

Several techniques for designing digital filters which approximate continuous filters are reported. Various discrete approximations to the continuous convolution integral are realizable as the solution of difference equations. These difference equations are the equations for digital filters. Rectangular, quadratic and higher order numerical integration rules lead to a continuum of digital filters of first, second, and higher order, respectively, making this a highly flexible approach for designing digital filters. Various discrete approximations to the differential equations characterizing the continuous system result in difference equations characterizing the digital filter. Discussed are two first order approximations and a quadratic approximation. A frequency domain approach is presented whereby the frequency characteristics of the digital filter are mapped closer to those of the continuous filter by a multiplicative compensating polynomial. The harmonic responses of various standard examples are compared with one another and with the results of other methods of realizing digital filters. Author

N70-20612*# Massachusetts Univ., Amherst.
[STATISTICAL AND STABILITY ANALYSES OF NEURAL PULSE FREQUENCY MODULATOR] Semiannual Status Report, Period Ending 1 Feb. 1969
R. V. Monopoli and C. E. Hutchinson Feb. 1970 11 p refs
(Grant NGR-22-010-018)
(NASA-CR-108981) Avail: CFSTI CSCL 09C

Details of progress made in determining the statistical properties of the output of a neural pulse frequency modulator when the output is a zero mean stationary Gaussian random process which is exponentially autocorrelated is given. Progress in finding a suitable approach to the stability analysis problem in sampled data closed loop control system is also given. Author

N70-20670# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
EFFICIENT ALGORITHMS FOR IMPLEMENTING THE ITERATIVE PIECEWISE-LINEAR METHOD
L. O. Chua Sep. 1969 33 p refs
(Grant NSF GK-2988)
(TR-EE-69-21) Avail: Issuing Activity

Two efficient computer algorithms are presented for finding the dc solutions of resistive nonlinear networks containing 2-terminal linear and nonlinear resistors, independent dc voltage and current sources, and linear controlled sources. The first algorithm is designed specifically for networks with multiple solutions, while the second algorithm is designed for networks with a unique solution. The first algorithm is based on the sign of the hybrid parameters associated with the linear n-port portion of the network. The second algorithm is a piecewise-linear version of the Newton-Raphson method, but it differs from the continuous version in two important aspects. The iteration formula depends not directly on the solution at the preceding iteration, but on the updated segment combination. These observations lead to an algorithm which assures that the piecewise-linear version of Newton-Raphson formula will always converge. Moreover, an important connection between the two algorithms is established on the basis that the iteration formula for the second algorithm is identical to the network equations associated with the first algorithm. Author

N70-20908*# Rochester Univ., N.Y. Center for System Science.
THE INVERSE PROBLEM OF THE OPTIMAL REGULATOR
Ryuzo Yokoyama (Ph.D. Thesis) Dec. 1969 286 p refs
(Grant NGR-33-019-014)
(NASA-CR-109079; CSS-69-12) Avail: CFSTI CSCL 09C

A new phase canonical form is given for a class of multi-input dynamical systems described by time invariant ordinary differential equations. This is based on a modified definition of an equivalent relation for the class of systems. It is shown that a characteristic quantity called a stage distribution defined with respect to the linear part of the system uniquely determines the structure of its canonical form. The inverse problem of the optimal regulator is considered for this class of systems with integral type performance indices. A convenient analysis of this problem is possible, using the developed phase canonical form. A theorem is stated which asserts necessary and sufficient conditions for optimized performance indices for a specified feedback control law. Author

N70-20688# Akademiya Nauk URSR, Kiev.
REMOVING THE REACTANCE EFFECT OF COUPLING LEADS IN BRIDGE TYPE TEMPERATURE CONTROL

CIRCUITS

Ya. V. Boris, B. M. Katz, and O. A. Kyuzdeni *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 51–57 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

With an increase in supply frequency, the bridge output will generally include a noncompensated quadrature component of voltage due to the capacitive reactance which reduces the sensitivity and lowers measurement accuracy. To minimize this capacitive effect, a fourth lead to the multiconductor cable is proposed and ways of connecting this dummy line in the bridge circuit are discussed. This method provides a useful compensation with either shielded or nonshielded cable. The amount of distributed capacitance between the lines and from line to shield for the usual three-wire case and for the proposed four-wire case is depicted. Experimental tests support the value of the proposal. B.E.S.

N70-20960# Akademiya Nauk URSR, Kiev.
ON THE SENSITIVITY STABILITY OF SECOND HARMONIC MAGNETIC MODULATORS WITH RESPECT TO THE OPERATING MODE OF EXCITATION AND THE MEASURING CIRCUIT

R. Ya. Berkman and B. L. Bondaruk *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 69–75 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Ways in which the inherent stability of the magnetic modulator elements can be maximized are considered, particularly in situations where a wide range of temperatures and other variables may be encountered, and also in regard to mass production with considerable variation in magnetic core parameters. The analysis assumes that modulator core parameters, such as the dimensions of the core and the number of the core windings, are constant. The saturation inductance and the maximum differential permeability are chosen as the most significant variables which determine the sensitivity stability. The analysis is based on the various possible combinations of these two variables and their combined effect on stability variation of the core. Analytical results were verified by experimental tests on two magnetic modulators using cores of type 79 NM and 80NSH permalloy. Excitation was at 40 HZ and tests were conducted over temperature ranges from 20 to 200 C. The results are summarized with respect to stability sensitivity as affected by the excitation loads and the working load on the modulator. The stability is affected more significantly by the load on the measuring winding. A variation in sensitivity stability of only + or − 7% was achieved for cases where maximum differential permeability over a temperature range of 20 to 200 C varied by a factor of 7. B.E.S.

N70-20966# Akademiya Nauk URSR, Kiev.
MATHEMATICAL MODELING OF CONTROLLED CHOKES WITH MAGNETIC FEEDBACK

Yu. P. Razuvayev *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 103–113 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A modeling technique is developed for magnetically biased elements and circuits with stable operating modes for a wide range of designs (e.g., single and triple-phased controlled chokes and regulators, and frequency multipliers and dividers). A controlled circuit having internal negative feedback and an AC output is analyzed. Equations are derived which take into account the effects of nonlinearity in the magnetic elements. An idealized block diagram is drawn which incorporates typical amplification and control elements based on magnetic devices. Sample oscillograms are presented of voltage and current readings taken at various points in a controlled choke experimental model having internal negative feedback. B.E.S.

N70-20973# Akademiya Nauk URSR, Kiev.
RELAXATION CIRCUIT WITH CONTROLLED p-n-p-n JUNCTION USING p-n-p AND n-p-n TRANSISTORS

A. M. Agizim, Yu. I. Spektor, and N. T. Fuchila *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 160–164 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

Relaxation oscillators are examined that are based on semiconductor triodes which have a broad application in automatic control, measuring, and impulse type devices. An example of a practical circuit of this type is given together with a schematic. In this circuit, a switching current of less than three microamps is obtained. B.E.S.

N70-20974# Akademiya Nauk URSR, Kiev.
QUESTIONS ON COMPUTATION OF CONTROLLED p-n-p-n JUNCTIONS

A. M. Agizim and Yu. I. Spektor *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 165–170 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A low-power controlled circuit is discussed consisting of one p-n-p and one n-p-n type transistor. The conditions are established which, for a given threshold voltage and load impedance, allow determination of the fundamental circuit parameters. These are switch-on current and switch-off current, and the slope of the volt-ampere. On the basis of relationships presented, it is possible, within certain limits, to synthesize a controllable p-n-p-n-switch with a given range of desired characteristics. Practical examples are given using existing types of transistors, reasonable ranges of temperatures, and input voltage conditions. B.E.S.

N70-21037# Akademiya Nauk URSR, Kiev.
CERTAIN PROBLEMS OF DEVELOPING AERIAL ELECTRIC GEOPHYSICAL PROSPECTING EQUIPMENT BY THE TRANSIENT RESPONSE METHOD

A. S. Lutsyshin *In its* The Selection and Transmission of Inform., No. 17 1968 p 94–101 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

Engineering solutions for constructing the basic units and stages of the measuring device by the transient response method and the technical requirements for them are given. The principle of shaping switch-controlling pulses is studied, and the principal circuits for the pulse amplifier, the time-delay stage, and the coincidence circuits are described. Transl. by H.W.

N70-21045# Akademiya Nauk URSR, Kiev.
AN OPTIMALIZING DIODE DEVICE FOR ROOT-MEAN-SQUARE ADDITION

V. I. Gol'dgefter and R. V. Prots *In its* The Selection and Transmission of Inform., No. 17 1968 p 156–164 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

A method of calculation is given and the principal circuit is described for a device for the root-mean-square addition of two independent slowly varying voltages. Data are presented on the errors and effectiveness of applying this circuit. The circuit is simple in design and operates reliably in the 10 to 40 deg temperature range. In some cases this circuit is preferred to circuits which operate on the principle of two-phase frequency conversion, particularly if it is necessary to add partial or single voltages. Designing the circuit around diodes permits series connection of a number of circuits for several addition voltages. Transl. by H.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-19744# Los Alamos Scientific Lab., N. Mex.
DOOR ALARM AND INTERLOCK SYSTEM AT THE LOS ALAMOS TANDEM ACCELERATOR FACILITY
Thomas P. Seitz, Harold J. Lang, and Richard L. Henkel 11 Sep. 1969 6 p refs
(Contract W-7405-eng-36)
(LA-4262) Avail: CFSTI

Like most accelerator facilities, the Los Alamos tandem accelerator facility was designed to provide adequate radiation shielding to personnel. To permit maximum use of the facility during accelerator operation, a door alarm and interlock system was designed to control access to areas of possible radiation. The system provides a programmed method of selecting various control conditions for entrances to radiation areas, depending upon the amount of radiation in the area and the amount of control desired. This enables personnel to work safely in given areas while experiments are in progress in other areas. Author (NSA)

N70-19866*# Lockheed Missiles and Space Co., Huntsville, Ala.
SATURN 5-LAUNCHER-UMBILICAL TOWER VIBRATION ANALYSIS. VOLUME 1: RESPONSE TO GROUND WIND EXCITATION Final Report
C. E. Jones 30 Apr. 1969 94 p refs
(Contract NAS8-21301)
(HREC-1301-2; LMSC/HREC-D148844-1) Avail: CFSTI CSCL 22D

Methods for calculating the vibrational characteristics and the ground-wind induced response of the Saturn 5-Launcher-Umbilical tower combination are described. The general features of the mathematical model are discussed and the techniques used to solve eigen-problems and response problems are described. A digital program was prepared to implement the formulation. Input to the program consists of concise descriptions of displacement functions used to characterize vehicle and tower motions, damping coefficients, forcing function descriptions, etc. Program output includes complete solution information with optional SC 4020 plots of the response of the vehicle and tower at three specified elevations. Results (both eigenproblem and response solutions) obtained for the Saturn 501 configuration are presented. Author

N70-19901*# Farrand Optical Co., Inc., New York.
INFINITY DISPLAY OPTICAL UNIT: PANCAKE WINDOW, PATENT 3,443,858 Final Technical Report
Nov. 1969 46 p
(Contract NAS9-8140)
(NASA-CR-102175; PTR-2096-463) Avail: CFSTI CSCL 14B

An infinity display optical unit is described for use in simulators for aerial or space training devices. The device presents to the eye of the observer scenes or objects appearing on a spherical surface at the object plane in such a manner as to make the projected scenes or objects appear to be optically at infinity. A high degree of realism is achieved by the use of the pancake window as a mirror eyepiece whose focal plane may be at the observer's eye to provide a field of view of approximately 70 deg. The mechanical design and principles of operation of the device are described. R.B.

N70-20295# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
DEVELOPMENT AND EVALUATION OF AN APPARATUS FOR THE DIRECT TENSILE TESTING OF ICE
Ivor Hawkes Oct. 1969 31 p refs
(AD-698022; CRREL-SR-131) Avail: CFSTI CSCL 14/2

The report discusses the theory of the uniaxial tensile test of a brittle material and describes in detail the development and calibration of an apparatus designed to subject fine-grained polycrystalline ice specimens to uniaxial tensile and compressive loads up to failure, and to give a continuous stress-strain curve during the loading cycle. Author (TAB)

N70-20427*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GROUND SIMULATION OF A MARS-ENTRY-CAPSULE AEROSHELL ENVIRONMENTAL HISTORY
Robert G. Nagler 15 Feb. 1970 18 p refs
(Contract NAS7-100)
(NASA-CR-108897; JPL-TR-32-1466) Avail: CFSTI CSCL 14B

The design of a single facility is described which is meant to provide reasonable Martian simulation of chemical surface decontamination, dry heat sterilization, launch pumpdown, transit vacuum and temperatures, and the simultaneous entry heat and pressure pulses. Author

N70-20486*# Georgia Inst. of Tech., Atlanta. School of Aerospace Medicine.
BEHAVIOR OF NOZZLES AND ACOUSTIC LINERS IN THREE-DIMENSIONAL ACOUSTIC FIELDS Quarterly Report, 1 Sep. – 31 Dec. 1969
Ben T. Zinn, Allan J. Smith, Jr., and B. Robert Daniel 31 Dec. 1969 8 p
(Grant NGR-11-002-085)
(NASA-CR-108911) Avail: CFSTI CSCL 14B

Theoretical studies were continued on the analysis of three-dimensional wave propagation in a circular duct containing a through steady state flow and attenuating side walls and on obtaining admittance functions for nozzles of arbitrary shape. The installation and preliminary checkout of the test facility are reported, with the final checkout begun. Installation of all instrumentation and circuitry is also complete, and the majority of circuits are checked out. N.E.N.

N70-20773*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PLASMA ARC JET FACILITY FOR EXTRATERRESTRIAL ATMOSPHERIC ENTRY STUDIES
T. F. Moran 1 Mar. 1970 37 p refs
(Contract NAS7-100)
(NASA-CR-109125; JPL-TM-33-442) Avail: CFSTI CSCL 14B

A test facility for simulating the thermodynamic environments of planetary atmospheric entry has been designed and built at JPL. The facility uses a plasma arc jet and plasma arc lamps to provide the combined convective-radiative heat loads encountered in Mars entry and certain Venus entry conditions. A vacuum test chamber and pumping system allow pressure simulation and arc designed to permit pulsing for exact matching of trajectory pressure-time relationships. Details of the facility design, capabilities, and status are given. Author

N70-21008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VARIABLE ANGLE TUBE HOLDER Patent Appl.
Artie D. Jessup, inventor (to NASA) Filed 5 Nov. 1969 8 p
(NASA-Case-LAR-10507-1; US-Patent-Appl-SN-874177) Avail: CFSTI CSCL 14B

A variable angle tube holder is described for enabling laboratory personnel to make agar slants at any angle from the horizontal to the vertical. A frame member is provided which includes two vertical ends and at least one horizontal member secured to and maintaining the vertical ends in a fixed space relationship. A test

tube rack capable of holding several test tubes is suspended between the two ends of the frame by an axle extending from the rack through each end member. NASA

N70-21089# Stanford Research Inst., Menlo Park, Calif.
DESIGN STUDY OF A TACTILE CUING SYSTEM FOR PILOT TRAINING Final Report, 1 Feb. 1968-15 Jul. 1969
John W. Hill, Kenneth W. Gardiner, and James C. Bliss Aug. 1969 115 p refs
(Contract F33615-68-C-1435)
(AD-697991; AFHRL-TR-6912) Avail: CFSTI CSCL 14/2

Several vibrator, air jet, and moving-button tactile stimulator-units were evaluated as cuing aids for pilot training in a manual tracking task. The best units, as determined by minimum mean square error and best operator describing function were built into a flight simulator. These units were further evaluated for their ability to help pilots control the trainer in some flight-simulation tracking tasks such as altitude holding and ILS landing. A one-dimensional tactile cuing system was designed using information obtained from these experiments. The cuing system, which consisted of two vibrators attached to the arms indicating heading error in excess of five degrees, was tested in a controlled experiment with four pilots having less than 200 hours of flight time. A selected review of the literature and current research was carried out to assess the feasibility and appropriateness of biostimulation and bioelectric control for pilot training and aircraft control. Author (TAB)

N70-21085# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
NORMAL AND SUPER CONDUCTIVITY HIGH-FREQUENCY ACCELERATOR AS POWER SOURCES FOR ELECTRON MICROSCOPES [NORMAL- UND SUPRALEITENDE HOCHFREQUENZBESCHLEUNIGER ALS SPANNUNGSQUELLEN FUER ELEKTPONENMIKROSKOPE]
Cord Passow Apr. 1969 31 p refs In GERMAN; ENGLISH summary
(KFK-957) Avail: CFSTI

The use of linear accelerators as a high-voltage electron source for an electron microscope is discussed. Some qualities of different normal and superconducting accelerators are considered with respect to this application. It seems that, because of its high duty cycle, a superconductor accelerator is a feasible source. Some problems of cryotechnics and voltage control as well as some problems of particle dynamics have to be solved to get a maximum duty cycle gas. Author (NSA)

N70-21104*# Barnes Engineering Co., Stamford, Conn.
FEASIBILITY STUDY FOR AN EARTH SIMULATING INFRARED SOURCE
Robert B. McIntosh and Roger L. Hoelter Dec. 1969 53 p
(Contract NAS5-21049)
(NASA-CR-109091) Avail: CFSTI CSCL 14B

The feasibility of fabricating an infrared source for simulating earthshine radiation in a thermal-vacuum chamber was investigated. A circular array of sources is required to simulate both the spectral radiant emittance and the total energy exchanged between the earth and a test specimen. High temperature sources were investigated which use scatter filters to achieve spectral matching. This application of scatter filtering proved to be unfeasible when an attempt was made to incorporate a filter in a practical optical configuration. A more promising source is recommended which uses the emissive properties of heated, infrared-transmitting crystals and is technically feasible and economically practical. A source consisting of 70% calcium fluoride, 20% magnesium fluoride, and 10% sapphire heated to 800 K will produce a source spectrum which lies within the tolerance band defined by the spectral radiances of black bodies operated at 250 K and 300 K in the wavelength region from 4 to 17 microns. The source's total radiant power output may be matched to the earth's over earth temperatures between 250 K and 300 K by varying the number of sources in the simulator array. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-19741# United Kingdom Atomic Energy Authority, Harwell (England).
LIQUID ENTRAINMENT IN ADIABATIC STEAM-WATER FLOW
G. F. Hewitt and D. J. Pulling Jun. 1969 11 p refs
(AERE-R-5374) Avail: CFSTI

Measurements of liquid entrainment are reported for the annular flow of steam-water mixtures in the pressure range 25 to 50 psig in a 0.366 in. bore tube. The mass velocity was fixed at 219,000 lb sq. ft. hr in the quality range 10 to 80%. The entrainment was determined by measuring the film flow using a porous wall device and subtracting this film flow from the known water flow. The entrainment flowrate passed through a maximum with increasing quality. Comparison of the data with the correlation of Truong Quang Minh and Huyghe (1965) showed systematic variations, and it seems that correlations of this relatively simple type are inadequate in describing equilibrium entrainment data. Author (NSA)

N70-19762*# IIT Research Inst., Chicago, Ill. Engineering Mechanics Div.
BASE FLOW AND SEPARATION STUDIES Final Report, 22 Jun. 1966 – 31 Jul. 1968
R. S. Norman Sep. 1968 112 p refs
(Contract NAS8-20392)
(NASA-CR-102460) Avail: CFSTI CSCL 20D

This experimental study was performed at a Mach number of 2.97 over a Reynolds number range of 6.5 million to 41 million. Measurements were made in the base recirculation region behind a two-dimensional, blunt trailing edge model. Base pressure values corresponded to previous experimental data. Hot wire measurements of mean and fluctuating velocities indicated turbulence intensities of 40 to 100 percent near the model base. Power spectra of the base boundary layer were similar to typical turbulent boundary layers. Total temperatures in the recirculation region were slightly less than free stream recovery temperature far from the base and showed a thin thermal boundary layer close to the cooled base surface. Heat transfer data shows that the base boundary layer was the major resistance to convective heating. Non-dimensionalized heat transfer coefficients showed little dependence on Reynolds number. Author

N70-19767*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIRECT MEASUREMENTS OF TURBULENT SKIN FRICTION ON A NONADIABATIC FLAT PLATE AT MACH NUMBER 6.5 AND COMPARISONS WITH EIGHT THEORIES
Edward J. Hopkins, Earl R. Keener, and Pearl T. Louie Washington Feb. 1970 33 p refs
(NASA-TN-D-5675; A-3295) Avail: CFSTI CSCL 20 D

The local turbulent skin friction was directly measured with a floating-element balance mounted flush in a sharp-edged flat plate. The Mach number was 6.5, the length Reynolds number ranged from about 0.7 to 14 million, and the ratio of wall-to-adiabatic-wall temperature ranged from 0.3 to 0.5. The skin friction results were used to evaluate eight theories on a generalized basis by

determining which theory gives the best transformation of the data onto an incompressible skin friction curve. This evaluation indicates that the best predictions of skin friction (within about 5 percent) are given by the Van Driest II or Coles theories when momentum thickness Reynolds number is used. The uncertainty introduced by theories that require estimates of a virtual origin of turbulent flow is demonstrated. Author

N70-19792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Environmental Sciences Div.

SHOCK-WAVE STRUCTURE OF A GAS HAVING ROTATIONAL AND VIBRATIONAL RELAXATION

R. Passamaneck 1 Feb. 1970 18 p refs

(Contract NAS7-100)

(NASA-CR-108230; JPL-TR-32-1448) Avail: CFSTI CSCL 20D

One-dimensional Navier–Stokes equations are used along with two relaxation equations to solve the shock-wave structure for a gas having both rotational and vibrational modes of relaxation. The characteristic relaxation times, as well as Mach number, are varied in order to note the corresponding nonequilibrium effects. Viscosity and heat conduction coefficients are allowed to vary as functions of temperature. The results presented were obtained by numerical integration of a nonlinear set of three differential equations of a boundary value type in which both boundaries exhibited singularities. Author

N70-19853# Joint Publications Research Service, Washington, D.C.

CALCULATING SELF-EXCITING GAS DYNAMIC OSCILLATIONS IN HEAT EXCHANGER GASLINES

V. I. Zinchenko et al *In its* Improving the Conditions of Labor in the Merchant Fleet Noise Control on Seagoing Ships 18 Dec. 1969 p 13-24 refs (See N70-19851 08-23)

Avail: CFSTI

Investigations show that the self-induced vibrations in heat exchanger gas lines depends on the geometric parameter of the gas line, the gas temperature beyond the tube bank, the velocity of the gases flowing over the tube bank, and the Strouhal number. A model of any dimensions can be constructed by varying the given parameters, and a self-induced gas dynamic process can be derived. It is shown that the vibrations can be eliminated by dividing the gas line into sections by longitudinal baffles. R.B.

N70-19887# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

INSTITUTE FOR AEROSPACE STUDIES Annual Progress Report, 1969

Nov. 1969 188 p refs Presented at the 7th Intern. Shock Tube Symp., Toronto, Canada, 23–25 Jun. 1969

Avail: CFSTI

The research programs at the University of Toronto Institute for Aerospace are reported. The research effort was concentrated in the areas of aeronautics, space technology and sciences, and flight transportation. Eight invited papers and 34 contributed papers are presented. Included are the significant developments in hypersonics, aerodynamic turbulence, sonic booms diffraction, and plasma studies. F.O.S.

N70-19909 Honeywell, Inc., St. Paul, Minn. Systems and Research Center.

A SURVEY OF FLUIDIC COMPONENTS AND THEIR APPLICATION TO GAS TURBINE CONTROL

R. J. Reilly *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 379–439 refs (See N70-19902 08-28)

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The diverse efforts have resulted in a variety of devices for sensing amplifying and controlling with fluid power, without the use of moving parts. The various devices and techniques, significant design parameters of beam deflection amplifiers, and gas turbine control systems are reviewed. Author

N70-19998 National Lending Library For Science and Technology, Boston Spa (England).

MASS EXCHANGE UPON CONDENSATION OF WATER VAPOUR OUT OF A VAPOUR-AIR MIXTURE MOVING INSIDE A SPIRAL COIL [ISSLEDOVANIE MASSOOBMENA PRI KONDENSATSII VODYANOGO PARA IZ PAPOVOZDUSHNOI SMESI, DVIZHUSHCHEISYA VNUTRI VINTOVOGO ZMEEVIKA]

B. D. Tairov Dec. 1969 3 p refs Transl. into ENGLISH from Izv. Akad. Nauk Turk. SSR, Ser. Fiz. Tekh. Khim. i Geol. Nauk (USSR), no. 6, 1966 p 115–116

(NLL-RTS-5389) Avail: Natl. Lending Library, Boston Spa, Engl.; 5s or 1 NLL photocopy coupons

The degree of intensification of the process under consideration due to the action of centrifugal forces when a vapor-gas mixture moves through a curved channel was studied. Calculations of the coefficient of turbulent diffusion during mass exchange were compared to experimental data. The good agreement obtained suggests that the coefficient of turbulent diffusion satisfactorily allows for the effect of turbulent intermixing on the intensity of the process. In comparison with straight tubes, a significant intensification of the process of water vapor condensation from a vapor-air mixture inside spiral coils was indicated. D.L.G.

N70-20030 National Lending Library for Science and Technology, Boston Spa (England).

INVESTIGATION OF MIXING OF A HORIZONTAL JET WITH A FLUIDIZED BED [ISSLEDOVANIE PEREMESHIVANIYA GORIZONTALNOI STRUI S PSEVDOOZHIZHENNYM SLOEM]

A. P. Lummi et al 28 Nov. 1969 6 p refs Transl. into ENGLISH from Khim. Prom (Leningrad), v. 43, no. 7 p 522–523 In ENGLISH and RUSSIAN

(NLL-M-7848-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The mixing of the main flow of the fluidizing agent in chemical processes with the additional volume injected into the bed is studied by elution of a tracer added to the jet. The fluidizing air was injected into the bed through gas distributors and the tracer consisted of carbon dioxide. The secondary air was injected through a nozzle. Visual observation showed that in the case of interaction with a fluidized bed containing large bubbles, the jet has no definite position; its axis changes direction continually under the effects of bubbles rising to the surface. G.G.

N70-20048# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

LARGE CIRCULATING DROPS IN VERTICAL TUBES

V. O'Brien Sep. 1969 88 p refs

(Contract NOw-62-0604-c)

(AD-697907; APL-TG-1084) Avail: CFSTI CSCL 20/4

Large drops falling or rising within vertical tubes containing other fluids are studied experimentally and theoretically. For an ideal nonresistive interface the roles of Bond number, Reynolds number, and a gravity-viscous number, along with density ratio and viscosity ratio, in determining the velocity, shape, and circulation of the drops are described. Dynamic theoretical relationships are derived and used to correlate available data. Discussions on the static shape and the critical Bond number are included for completeness. Many drop-fluid systems do not behave as if the interface were ideal. The buoyancy-driven drop within a vertical tube is suggested as a tractable physical system to study such interfaces. Author (TAB)

N70-20078 California Univ., Berkeley.
ON CONVERGENCE OF NAVIER-STOKES FLOW TO IDEAL FLOW IN R SUB 3
Howard Story Gray Swann (Ph.D. Thesis) 1968 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-10393

A solution, local in time, to the Navier-Stokes equations for viscous incompressible flow in R3 is found and the solution converges to a function that is the solution for ideal flow in R3 as the viscosity goes to zero. The Euler equations for ideal flow differ from the Navier-Stokes equations (E^*) only in that the viscosity term does not occur in the Euler equations. Equations (E) derived by formally computing the curl of the Navier-Stokes equations (E^*) are solved. In solving the auxiliary problem (E) the following version of the Schauder fixed point theorem is used: Let S be a closed convex subset of a Banach space X and let F be a continuous operator on S such that F(S) is contained in S and F(S) is a relatively compact subset of X. Then there is a fixed point y in S, i.e., F(y) = y. The solutions to the Navier-Stokes equation for various viscosities converge to a function that is a solution to the Euler equations for an ideal fluid. Dissert. Abstr.

N70-20085 Rhode Island Univ., Kingston.
HEAT AND MOMENTUM TRANSPORT IN DILUTE POLYETHYLENE OXIDE SOLUTIONS
William Arthur McNally (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9840

The purpose of this investigation was to study the turbulent pipe flow of dilute aqueous solutions of polyethylene oxide. Previous investigators have shown that remarkably low friction factors are obtained with this and other high molecular weight, linear, water-soluble polymers in turbulent flow within smooth pipes. In particular this investigation was concerned with measurement of polymer solution friction factors in hydraulically rough pipe and with measurement of heat transfer coefficients in smooth pipes. The data were used to draw inferences about the mechanism of polymeric friction reduction and to test the theories which have been put forth in the literature concerning the phenomenon. It was found that the heat transfer coefficients are reduced as substantially as the smooth wall friction factors for these solutions. Dissert. Abstr.

N70-20105 Tennessee Univ., Knoxville.
AN ANALYTICAL INVESTIGATION OF THE STEADY STATE ONE-DIMENSIONAL MHD SHOCK WAVE STRUCTURE USING CONTINUUM FLUID THEORY
Wilford Fu Wong (Ph.D. Thesis) 1968 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-7190

A magnetohydrodynamic (MHD) shock wave is investigated using continuum field theory with Maxwell's electromagnetic field equations and considering all dissipative mechanisms to be finite for a fully ionized gas. Shock profiles are presented to show the effects of velocity, magnetic field, electrical conductivity, and the current inertia terms in the generalized Ohm's law. The equations are analyzed by the method of phase space analysis. Conditions are defined for the simultaneous solution of three variables in phase space. In one special case, four variables are solved simultaneously in phase space. All numerical solutions were obtained with an IBM 360 computer. The results show the current inertia terms primarily affect the charge density and electric field profiles. A dimensionless parameter is defined which measures the importance of the current inertia terms in the shock problem. The significance of this parameter in macroscopic MHD problem is also discussed. Dissert. Abstr.

N70-20117 Texas Univ., Austin.
TIME-DEPENDENT ROTATING FLOW IN A CYLINDRICAL CONTAINER
William Roger Briley (Ph.D. Thesis) 1968 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-8121

The time-dependent laminar motion of a viscous incompressible fluid has been investigated for rotating flow in a closed cylindrical container. The fluid completely fills the container, which is closed on both ends by disks. Finite difference techniques were used to obtain solutions of the complete axisymmetric Navier–Stokes equations. Three problems were considered: a velocity decay problem in which the container is impulsively stopped with the fluid initially rotating as a rigid body; a spin-up problem in which the container is impulsively rotated with the fluid initially at rest; and a reverse rotation problem in which the fluid initially rotates as a rigid body with the container, which is then impulsively given the same angular velocity in the opposite direction. The governing equations were formulated in terms of stream function and a variable related to vorticity. Alternating-direction-implicit methods were used to solve the parabolic and the elliptic equations. Dissert. Abstr.

N70-20142 Cornell Univ., New York.
MAGNETIC FLUID DYNAMICS
Richard Allen Curtis (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-5753

In this thesis the dynamic behavior of magnetically polarizable fluids is considered. A summary of the considerations establishing the governing equations for a continuum magnetic fluid is presented, including: a justification for the continuum approximation, the conservation equations, and the equation of state. A series of examples demonstrating characteristic magnetic fluid behavior are then presented. First, the effect of a thin obstacle on the pressure distribution in small disturbance magnetic fluid flow is calculated. Next, it is shown that a low frequency wave disturbance does not propagate in the fluid but is damped out within a skin-depth determined mainly by the heat capacity and thermal conductivity of the fluid. The behavior of magnetic fluids at a free surface is then examined. It is concluded that, for an initially level free surface, the velocity of free surface waves is given by the same expression as that for such waves in ordinary fluids except that the gravitational acceleration is now replaced by an effective "gravity". Dissert. Abstr.

N70-20154# United Kingdom Atomic Energy Authority, Harwell (England).
THE INFLUENCE OF HEAT FLUX, SUBCOOLING, WALL THICKNESS AND TYPE OF HEATING ON FILM FLOW IN THE EVAPORATION OF WATER IN A VERTICAL TUBE
G. F. Hewitt and D. J. Pulling Jun. 1969 20 p refs
(AERE-R-6117) Avail: CFSTI

Liquid film flow measurements in evaporating vertical flow are described and discussed. The effect of subcooling the inlet water feed and the effects of reduction of wall thickness by grinding were investigated using a tube of 0.366 in. diameter and fixed total mass velocity. Tests were also carried out under similar conditions with ac and dc heating. With the thinnest wall small differences with the two types of heating were observed, but ac effects could not be invoked in complete explanation of the small but significant effect of wall thickness on film flowrate. Tests are also reported in which the influence of heat flux on the rate of change of liquid entrainment flow with length was investigated in various regions. Under the conditions applying, heat flux appeared to have a negligible effect on net rate of entrainment or deposition. NSA

N70-20174 University of Southern Calif., Los Angeles.
ON THE VISCOUS HYPERSONIC BLUNT BODY PROBLEM: TWO DIMENSIONAL BODIES
Ernest Joe Der (Ph.D. Thesis) 1968 173 p

Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-6488

An analysis of the viscous flow past a symmetric two-dimensional blunt body with emphasis on the stagnation region is made based on the Navier–Stokes equations. It is found in this study that the shock structure consists of three regions; hence, three sets of asymptotic expansions are necessary to describe the flow in the shock structure. The outer region acts as a very thin transition layer between the freestream and the principal region of the shock structure. The principal region, in the middle of the shock structure, is a relatively thicker region. The inner region is a very thin transition layer between the principal shock structure region and the shock layer. Dissert. Abstr.

N70-20175 Utah Univ., Salt Lake City.
THE COMPLETE STRESS STATE OF FIVE VISCOELASTIC FLUIDS IN VISCOMETRIC FLOW
Melvin J. Miller (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $13.95/Microfilm $3.95 Order No. 68-17560

The complete rheological state of stress was determined for five concentrated solutions of three different polymers undergoing viscometric flow for shear rates. These fluids were sheared between cone-and-plate platens in a Model R-17 Weissenberg rheogoniometer. Five small nonflow semiconductor pressure transducers were mounted in the plate flush with the shearing surface at known radial positions. The transmitted-torque, the total-normal-force, and the local-normal-stress values representing the normal-stress distribution were measured simultaneously during shearing of the fluid. The primary and secondary normal stress differences were calculated by two methods of analysis: the integral method and the rim method. Dissert. Abstr.

N70-20198 National Lending Library for Science and Technology, Boston Spa (England).
MOVEMENT OF AN AIR BUBBLE IN A STATIONARY LIQUID: CRITICAL EVALUATION OF RESEARCH HITHERTO AND ITS INTERPRETATION
G. Benfratello 22 Dec. 1969 66 p refs Transl. into ENGLISH from l'Energia Elettrica (Italian), Aug. 1953 p 486-512 (NLL-RISLEY-Trans-1839-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .6 NLL photocopy coupons

Experiments with water agree sufficiently to define the rise characteristics of the bubbles but they do not explain them. These characteristics appear to be different from those relative to motion of a solid body, and enable the results to be combined in a strip in a diagram correlating the rate of rise with the bubble volume. This strip exhibits a characteristic hook, dividing it into three successive volume intervals corresponding to different natures of the trajectory, different shapes of the bubbles, and different laws of motion. In the case of liquids other than water, the results are less certain, do not clearly indicate the effect of the liquid characteristics, and do not appear to be capable of representation on generally-valid curves of dimensionless coordinates. The formulas for the rate of rise are largely empirical, and some plans for theoretical investigation are suggested as being most adequate for representing the phenomenon. Finally, an attempt is made to interpret the small number of experimental measurements of the expansion of the bubbles along the rise. Author

N70-20205 Pennsylvania State Univ., University Park.
EXPERIMENTAL AND NUMERICAL SIMULATION OF TWO-PHASE FLOW WITH INTERPHASE MASS TRANSFER IN ONE AND TWO DIMENSIONS
Wilmer Ernest Culham (Ph.D. Thesis) 1968 251 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 69-5539

Two-phase flow in porous media, with interchange of hydrocarbon components between the two phases, is important in many petroleum recovery processes. A mathematical model was developed that adequately describes such recovery processes in one and two dimensions. The mathematical model was developed by combining a continuity equation for each hydrocarbon component with an equation of motion, Darcy's law. This approach resulted in two quasi-linear partial differential equations which mathematically described the transient, two phase flow of a two-component hydrocarbon mixture in a porous medium in a manner that accounted for simultaneous interphase mass transfer. The principal assumptions invoked in the formulation of these equations were that capillary forces and diffusional effects were negligible and that thermodynamic equilibrium existed in the reservoir at all times. These equations were solved in one and two-dimensional space by numerical techniques. Dissert. Abstr.

N70-20206 California Univ., Berkeley.
AN EXPERIMENTAL STUDY OF THE STABILITY OF THIN LIQUID FILMS FLOWING DOWN A PLANE
William Bernard Krantz (Ph.D. Thesis) 1968 261 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.00 Order No. 69-3640

Two different momentum integral solutions are developed for the growth of a small disturbance on a thin film of liquid flowing down a plane. These theories establish the connection between the momentum integral approach of Kapaza and classical linear stability theory. A new correlation for the equilibrium wave amplitude is derived from an inspectional analysis of a non-linear amplitude equation. The design of a plane wetted-wall column and associated equipment which permit wave growth, wave velocity and equilibrium amplitude measurements at low Reynolds numbers for variable angle of inclination is described. Unique in this study is the ability to impress two-dimensional disturbances of controlled amplitude and frequency. Data for two white oils and data for water from the literature are compared to the linear stability theories. The ability of linear stability theory to predict the wave properties of small disturbances is established. Dissert. Abstr.

N70-20232 Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTS ON THE PRODUCTION OF LIQUID DROPLETS OF UNIFORM SIZE [EXPERIMENTE ZUR ERZEUGUNG VON FLUESSIGKEITSTROPFEN GLEICHER GROESSE]
J. Thelen, W. Trommsdorff, and H. Wiegand Sep. 1969 27 p refs Transl. into ENGLISH of German Report DLR-67-91 (RAE-Lib-Trans-1390) Avail: CFSTI

Experiments to produce uniform-sized droplets by the action of sound or ultrasound on liquid jets are described. The liquid is injected into stationary air at atmospheric pressure or in a low pressure chamber. The theory of the generation and stability of a series of droplets based on published work, is discussed and the apparatus for the generation of liquid droplets, and accessory measuring equipment, are described in detail. Author

N70-20315 Connecticut Univ., Storrs.
AN EXPERIMENTAL INVESTIGATION OF TURBULENCE DUE TO FORMS OF BED-ROUGHNESS
Sat Dev Khanna (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-2154

A typical sand-wave in the domain of ripples and dunes for a subcritical tranquil flow was evolved from the existing available field and laboratory data. Experimental observations regarding mean velocity distribution, angle of flow, static pressure distribution and longitudinal turbulence intensity are made all along this typical wave. The wave was reproduced in wood in a low turbulence wind tunnel specifically designed and constructed for this purpose. The measurements were made by hot-wire anemometry in air taking into account the dynamic similarity between water and air flow.

From these observations skin friction coefficient, form drag and other boundary layer parameters were evaluated to help analyze the process of sediment transport. It is shown that skin friction on a sand wave is less than that on flat bed but form drag is much higher resulting in total drag on a sand wave being about twice that on a flat bed. Dissert. Abstr.

N70-20378# Naval Ordnance Lab., White Oak, Md. Explosions Research Dept.

LONG RANGE PROPAGATION OF SPHERICAL SHOCKWAVES FROM EXPLOSIONS IN AIR

D. L. Lehto and R. A. Larson 22 Jul. 1969 24 p refs
(AD-698121; NOLTR-69-88) Avail: CFSTI CSCL 19/4

Hydrocode calculations for spherical shock propagation using the artificial-viscosity method are carried out to 0.2 psi overpressure for a nuclear explosion and for a TNT explosion. An ideal-gas integration from the literature is used to extend the results to .00016 psi. Author (TAB)

N70-20436*# Catholic Univ. of America, Washington, D.C. Dept. of Space Science and Physics.

DECAY OF WEAK TURBULENCE

S. C. Ling and T. T. Huang Jun. 1969 69 p refs
(GRANT NGR-09-005-035)
(NASA-CR-108921) Avail: CFSTI CSCL 20D

A detailed experimental investigation of the structure of weak turbulence generated by various single and multiple stage grids has been made. The weak turbulent fields were limited to those having no interaction with the mean flow field. The present study covers a range of Reynolds numbers of turbulence between 70 and 7. Components of turbulence were found to have equipartition of energy in the final stage of decay. When the Reynolds number of turbulence is < 30, the kinetic energy of turbulence decreases inversely as the square of decay time. All the length scales of turbulence increase as the square root of time, while the Reynolds number of turbulence decreases as the square root of time. Both the measured spectral and correlation functions showed self-preserving forms that were not in agreement with those predicted by the normal statistics of turbulence. The longitudinal correlation function is closer to a Cauchy's distribution than a Gaussian distribution function. All experimental evidences imply that in the final stage of decay the wave components of turbulence are not completely independent with unlimited degrees of freedom but are closely related to the kinetic model of a field consisting of a specific type of line vortices which are aged and essentially noninteracting. Author

N70-20537# Georgia Inst. of Tech., Atlanta.

THEORETICAL INVESTIGATION OF GAS MANAGEMENT IN ZERO-GRAVITY SPACE MANUFACTURING

Helmut F. Bauer and Julius Siekmann *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 346-350 refs (See N70-20517 08-30)
Avail: CFSTI

The proposed research has as its objective the management of gases in liquefied materials in a free suspended position in zero gravity environment. The investigation shall mainly center on the degassing of liquefied materials, which shall be accomplished by accelerating the material. Also the gas-liquid-interaction, as well as methods to distribute gas properly in liquefied materials of various viscosity and surface tension shall be studied. Author

N70-20552# Los Alamos Scientific Lab, N.Mex.

A NUMERICAL METHOD FOR SOLVING THE BOUNDARY LAYER EQUATIONS FOR GAS FLOW IN CIRCULAR TUBES WITH TRANSFER AND PROPERTY VARIATIONS

C. A. Bankston (Arizona Univ., Tucson) and D. M. Mc Eligot (Arizona Univ., Tucson) 7 Apr. 1969 42 p refs
(Contract W-7405-eng-36)
(LA-4149) Avail: CFSTI

Details of the formulation and use of a finite difference method for solving the boundary layer equations for steady gas flow in circular tubes are given. The method employs an implicit scheme which has proved to be stable even under highly nonlinear circumstances. Problems involving heat transfer with strong property variations in laminar or turbulent flow under arbitrary thermal boundary conditions can be solved. Author (NSA)

N70-20565*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY SURVEYS OF THE WALL BOUNDARY LAYER IN A MACH 6 AXISYMMETRIC TUNNEL

Robert A. Jones and William V. Feller Washington Dec. 1970 71 p refs
(NASA-TN-D-5620; L-6697) Avail: CFSTI CSCL 20D

Total-temperature and total-pressure distributions were measured in the boundary layer on the wall of a straight pipe test section at four different locations up to about 100 boundary-layer thicknesses downstream of the nozzle exit. The free-stream Mach number was approximately 6, the ratio of wall temperature to total temperature was about 0.68, and the momentum-thickness Reynolds number varied from 8000 to 80,000. Values of the local pitot pressure, Mach number, velocity, and temperature in the boundary layer are tabulated along with the integral properties of the boundary layer. Low-frequency temperature and pressure fluctuations were observed in the wall boundary layer, and corresponding temperature fluctuations were found near the wall of the stagnation chamber. Author

N70-20567*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL FLOW CHARACTERISTICS OF A SINGLE TURBULENT JET IMPINGING ON A FLAT PLATE

Peter Hyrcak, David T. Lee, James W. Gauntner, and John N. B. Livingood Washington Mar. 1970 33 p refs
(NASA-TN-D-5690; E-5239) Avail: CFSTI CSCL 20D

An experimental study of the flow characteristics of a circular air jet impinging on a smooth flat plate is described. Jets issuing from circular nozzles 0.125, 0.250, and 0.375 inch (0.317, 0.635 and 0.952 cm) in diameter were considered. Nozzle Reynolds numbers ranged from 600 to 100 000, and the normal distance between the nozzle exit and the plate was varied from 2 to 30 nozzle diameters. Some of the flow characteristics studied were potential core length, velocity and pressure distributions through the jet, spread of the jet, and velocity decay along the jet axis. Author

N70-20577*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

TURBULENCE MEASUREMENTS IN SUPERSONIC, SHOCK-FREE JETS BY THE OPTICAL CROSSED-BEAM METHOD

M. J. Fisher (IIT Res. Inst., Chicago, Ill.) and K. D. Johnston Washington Feb. 1970 118 p refs
(NASA-TN-D-5206) Avail: CFSTI CSCL 20D

A new optical crossed-beam technique was used to measure the turbulence properties of two supersonic, shock-free, cold air jets. The method is based on the absorption of ultraviolet radiation by air. The measurements were highly successful in that reasonable and consistent values of the turbulence properties such as convection speeds, length scales, and spectra with obtained, and the data generally followed the trends set by hot-wire measurements in subsonic jets. The most interesting feature of the crossed-beam technique is the possibility of a direct measurement of three-dimensional spectral density. However, the demonstration that

the crossed-beam technique can be used for turbulence measurements in supersonic flow is considered to be the major accomplishment. Author

N70-20583*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF WALL ROUGHNESS ON THE DAMPING OF LIQUID OSCILLATIONS IN RECTANGULAR TANKS
Frank M. Bugg Washington Mar. 1970 39 p refs
(NASA-TN-D-5687; M-159) Avail: CFSTI CSCL 20D

An experimental investigation was made to determine the effectiveness of wall roughness for damping liquid oscillations in rectangular tanks. Roughness with height equal to 0.427 percent of the wetted wall area gave damping 65 percent greater than the smooth wall damping. Comparisons were made with viscous damping theory. Author

N70-20584*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF VORTEX SHEDDING ON FUEL SLOSH DAMPING PREDICTIONS
Henry A. Cole, Jr. Washington Mar. 1970 26 p refs
(NASA-TN-D-5705; A-3322) Avail: CFSTI CSCL 20D

Predictions of fuel slosh damping by ring baffles in cylindrical tanks are shown to differ from experimental measurements by as much as 100 percent over a range of tank diameters from 12 to 112 inches, oscillation amplitudes from 0.1 to 1.5 baffle widths, and baffle depths of 0.3 to 0.5 tank radius. Agreement between experiments and predictions is brought to within 20 percent when corrections are included for transitional flow due to vortex shedding, generalized mass change due to translation, and wall damping. Author

N70-20588*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS JET IMPINGEMENT ON LIQUID SURFACES DURING WEIGHTLESSNESS
Thomas L. Labus Washington Mar. 1970 25 p refs
(NASA-TN-D-5720; E-5438) Avail: CFSTI CSCL 20D

As part of the continuing research into behavior of liquids in weightlessness, an experimental drop-tower investigation was conducted to determine the characteristics of a laminar gas jet impinging normally on a liquid surface during weightlessness. Surface penetration depths from a gas that exited from a circular nozzle with an initially parabolic velocity profile were correlated in terms of known systems parameters. Contact angles on the test container surfaces were restricted to 90 deg so that the liquid-gas interface remained flat during impingement. Also included are qualitative observations concerning the resulting cavity shape, bubble pinch-off, and, for the case of large gas jet momentums, cavity growth. Author

N70-20789# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.
MEASUREMENT OF GAS CONCENTRATIONS IN BOUNDARY LAYERS
Edmond A. Brun Nov. 1969 38 p refs In FRENCH
(REPT-69-3) Avail: CFSTI

Techniques are described which respond to certain principles of irreversible thermodynamic phenomena to measure gas concentration. Sample probes and various types distant analyzes, which includes mass spectrometry and chromotography, are given. Measurements are given for concentration levels with and without sensors located in the boundary layer. Techniques are compared for profiles of relative concentrations. Transl. by J.M.C.

N70-20800# California Univ., Santa Barbara. Mechanical Engineering Dept.
BOUNDARY LAYER COMPUTATION BY AN N PARAMETER INTEGRAL METHOD USING EXPONENTIALS
Hartmut H. Bossel 11 May 1969 33 p refs
(Contract N00014-67-A-0120-0005)
(AD-697679; UCSB-ME-69-8) Avail: CFSTI CSCL 20/4

A new integral method is presented for the accurate calculation of laminar boundary layer flows. The method is written for unspecified order N of approximation and permits rapid qualitative solutions for low N (1 or 2), and very accurate solutions for high N (3 to 5). Exponentials are used in the velocity approximation and as weighting functions. The resulting integral relations and a simple method for obtaining initial profile parameters are given. Results are presented for continuous and discontinuous external flow and suction conditions and for favorable and adverse pressure gradients covering the spectrum of boundary layer flows from stagnation point to separation. Author (TAB)

N70-20818*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
PSEUDO-VISCOSITY METHOD AND STARTING PROCESS IN A NOZZLE [METHODE DE PSEUDO-VISCOSITE ET PROBLEME DE L'AMORCAGE D'UNE TUYERE]
Pierre Laval Washington NASA Feb. 1970 28 p refs Transl. into ENGLISH from La Rech. Aerospatiale (French), no. 131, Jul.–Aug. 1969 p 4–16
(Contract NASw-1692)
(NASA-TT-F-12863) Avail: CFSTI CSCL 20D

The problem of the starting process in a nozzle with the assumption of one-dimensional flow (x, t) is treated numerically by a finite difference method using an artificial viscosity term. The nozzle is either a divergent channel or a divergent-convergent channel limited by two throats. Stationary sonic conditions are assumed to be established at the upstream throat almost instantly after the sudden removal of a diaphragm; initial conditions are those of a constant-section shock tube. Results are presented for the starting process in a divergent conical nozzle. They confirm results obtained using the method of unsteady characteristics (x, t) and show that the quasi-steady approximation of Glick and Hertzberg gives too small a value for the time of establishment of asymptotic steady flow. Author

N70-20844# California Univ., Livermore. Lawrence Radiation Lab.
TRUMP COMPUTER PROGRAM: CALCULATION OF TRANSIENT LAMINAR FLUID FLOW IN POROUS MEDIA
Arthur L. Edwards May 1969 39 p refs Sponsored by AEC
(UCRL-50664) Avail: CFSTI

The TRUMP program solves a general nonlinear parabolic partial differential equation, using an efficient and accurate numerical method. TRUMP was initially developed to solve problems involving heat transport and chemical reaction in multidimensional systems with arbitrary geometric configurations, initial and boundary conditions, and thermal and chemical properties, and with various modes of heat production and transport. A variety of mathematically analogous problems may be solved. The solution of transient or steady-state flow of a compressible fluid in a porous, permeable medium is described. This type of problem is of particular interest in the Plowshare Project experiments being carried out to determine the feasibility of using nuclear explosives to stimulate gas recovery from low-permeability gas-bearing formations. Author (NSA)

N70-20939# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF CAVITATION, VOLUME 1
A. D. Pernik 14 May 1969 223 p Transl. into ENGLISH from the book "Problemy Kavitatsii" Leningrad, Izd. Sudostr., 1966 p 1-439
(AD-697599; FTD-HT-23-802-Vol-1) Avail: CFSTI CSCL 20/4

The book presents a systematic analysis of problems related to cavitation flows beginning with the initial breaks in continuity to the formation of a large cavitation pocket connected with the streamlined body. It also describes the phenomenon of cavitation erosion accompanying individual forms of cavitation, and furnishes some data on noise formation caused by cavitation.
Author (TAB)

N70-20940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF CAVITATION, VOLUME 2
A. D. Pernik 14 May 1969 188 p refs Transl. into ENGLISH from the book "Problemy Kavitatsii" Leningrad, Izd. Sudostr., 1966 p 1-439
(AD-697601; FTD-HT-23-802-68-Vol-2) Avail: CFSTI CSCL 20/4

Contents: Cavitation in a sound wave -- noise generation during cavitation; cavitation erosion; and flows with strongly developed cavitation. TAB

N70-20995# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE SHOCK WAVE-BOUNDARY LAYER INTERACTION ON CURVED COMPRESSION SURFACES
Michael S. Holden 8 May 1969 61 p refs Presented at the Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow, 7-8 May 1969
(Contract F33615-67-C-1298)
(AD-697416) Avail: CFSTI CSCL 20/4

The paper describes a study of attached and separated laminar boundary layers over highly cooled, curved compression surfaces in a hypersonic airflow. In the theoretical study, the integral forms of the boundary layer equations for the conservation of mass, streamwise momentum, normal momentum, moment of streamwise momentum and energy were used to describe the development of attached and separated boundary layers on a curved surface. In the experimental study, skin friction, heat transfer and pressure measurements were made on a series of flat plate-cylindrical arc-wedge compression surfaces. It was found that separation first occurred on the compression surface downstream of the flat plate, and incipient separation could not always be detected by observing the first occurrence of an inflexion point in the pressure distribution. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-19812*# National Aeronautics and Space Administration, Washington, D.C.
MOON ROCK DISTRIBUTION
13 Feb. 1970 30 p
(NASA-News-Release-70-19) Avail: NASA Scientific and Technical Information Division

The plan for distribution of 28 pounds of Apollo 12 lunar material to scientists in the United States and 16 foreign countries is presented. Listings include: (1) the name of the investigator and institution, (2) the type of investigation to be conducted, and (3) the approximate sample allocation. D.L.G.

N70-19886# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC AND GEOELECTRIC OBSERVATIONS, 1968 (RAPID VARIATIONS)
1969 110 p
(Rept-9) Avail: CFSTI

Tables and graphs are presented for geomagnetic and geoelectric observations carried out by the Kakioka Magnetic Observatory during the Post-IGC, 1968. Rapid variations observations, derived from rapid-run magnetograms, and rapid-run and normal tellurigrams, provide data on atmospheric electric potential gradient, atmospheric electric conductivities, airglow; sunspots, magnetic storms, magnetic sudden impulses, magnetic solar flare effects, magnetic pulsations, and magnetic bays. E.M.C.

N70-19889*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Space Sciences Dept.
MATHEMATICAL ANALYSIS OF APERIODIC EVENTS (GEOMAGNETIC ACTIVITY) Final Technical Report
Nancy U. Crooker and Kenneth Moe Aug. 1969 46 p refs
(Contract NAS8-30156)
(NASA-CR-102470; MDC-G1142) Avail: CFSTI

A new method of making short-term predictions of K sub p and A sub p has been developed and tested, using the available solar and geophysical data for 1968. The method employs Pioneer 7 measurements of the solar wind speed as basic data. An attempt is made to separate the contributions to K sub p from recurrent storms and from flare-associated storms by using various storm precursor data. This first test of the method failed to produce the hoped for improvement, but did not disprove the method because the flare-associated precursors did not cover the full 24-hour day, and only one ten-minute sample of the solar wind speed was available each day. A further test of the method would be desirable when complete data becomes available. A number of suggestions for further research are made in this report. Long-term predictions of the annual average of K sub p and the Zurich relative sunspot number have also been developed in the present report. These predictions are based on earlier work by Gnevyshev, King-Hele and Xanthakis. Predicted values for each year until 2030 are presented in graphical and tabular form. These long-term predictions should satisfy the needs of the Marshall Space Flight Center for mission planning. Author

N70-19918# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 219
2 Jan. 1970 63 p refs Transl. into ENGLISH from various Russian publications
(JPRS-49541) Avail: CFSTI

CONTENTS:

1. ASTRONOMY p 1-6 refs (See N70-19919 08-30)
2. METEOROLOGY p 7-29 refs (See N70-19920 08-20)
3. OCEANOGRAPHY p 30-37 refs (See N70-19921 08-13)
4. TERRESTRIAL GEOPHYSICS p 38-39 refs (See N70-19922 08-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 40-55 refs (See N70-19923 08-13)

N70-19921# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astron., and Space, No. 219 2 Jan. 1970 p 30-37 refs (See N70-19918 08-13)
Avail: CFSTI

News and abstracted journal articles are presented on underwater acoustics, salinity determinations, sealab excursions, computer calculations, bathymeters and instrumentation and internal surface, and tidal waves and their formation. N.E.N.

N70-19922# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astron., and Space, No. 219 2 Jan. 1970 p 38–39 refs (See N70-19918 08-13)
Avail: CFSTI

A nuclear resonance differential geomagnetometer for measuring very small differences in the magnetic field is briefly described. A method for detecting anomalies of secular variation of the geomagnetic field with a highly precise magnetometer is also mentioned. N.E.N.

N70-19923# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res., in Geophys., Astron., and Space, No. 219 2 Jan. 1970 p 40–55 refs (See N70-19918 08-13)
Avail: CFSTI

Brief descriptions are given on atmospheric measuring instruments, metal welding in space, structure of interplanetary space, and use of military communications satellites. The instruments are for determining neutron and meson components and variations in cosmic rays, effects of cosmic rays in ionosphere, underground measurement of cosmic rays, meteor positions, radio propagation, atmospheric circulation and wind measurements, electron and gamma quanta in the upper atmosphere, geomagnetic inhomogeneities, and twilight sky data. N.E.N.

N70-19928*# Colorado State Univ., Fort Collins.
EXTINCTION OF INFRARED RADIATION DUE TO ATMOSPHERIC HAZE
Yunn Pann and William Marlatt *In its* Biol. and Eng. of Space and Planetary Life Systems Sep. 1969 15 p refs (See N70-19925 08-34)
Avail: CFSTI

The effects of surface emissivity and atmospheric transmissivity on the evaluation of aircraft and satellite measurements of upward infrared radiation flux from the earth's surface were studied. Radiometer measurements of upflux over various surfaces and through different air masses were compared with computed values from a theoretical model of atmospheric radiation transfer in order to analyze the role of haze extinction in the 8 to 14 micron atmospheric transmission window. It was found that the most significant factors affecting the upflux of infrared radiation are temperature and emissivity of the active surface. G.G.

N70-19933# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
INVESTIGATION OF THE SCREENED EARTH MAGNETIC FIELD BY USING THE INDUCTOR PERMALLOY CORE OF THE LINEAR INDUCTION ACCELERATOR
P. S. Antsupov, I. M. Matora, and L. A. Merkulov 1969 10 p refs In RUSSIAN
(JINR-P9-4498) Avail: AEC Depository Libraries

The measurement results of the residual geomagnetic field in the neighbourhood of the linear induction accelerator axis are presented. Author (NSA)

N70-19941 National Lending Library for Science and Technology, Boston Spa (England).
SYNOPTICAL HYDROGRAPHY IN THE NORTH SEA
E. Mittelstaedt 28 Nov. 1969 19 p refs Transl. into ENGLISH from Deut. Wiss. Komm. Meeresforsch. (Hamburg), v. 20, no. 1, 1969 p 1–20
(NLL-M-7872-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The accuracy of sea surface temperature analyses based on temperature observations from ships is discussed. The mean error of sea surface analyses in the North Sea is estimated to be + or – 0.5 C. The maximum error amounts to + or – 1 C. Quasi-synoptic temperature charts obtained by ship reports demonstrate several examples of the variability of the sea surface temperature in the North Sea. The significance of such quasi-synoptic charts with regard to the forecast of the temperature field at the surface and at the bottom of the North Sea as well is mentioned. Author

N70-20020 Stanford Univ., Calif.
MAGNETIC PROPERTIES OF ULTRAMAFIC ROCKS FROM RED MOUNTAIN, CALIFORNIA
Afif Hani Saad 1968 68 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-8256

Samples from the Red Mountain ultramafic intrusion were collected for the purpose of studying the remanent magnetism and susceptibility of ultramafic rocks. To establish the degree of serpentinization, grain densities were accurately determined from bulk densities by taking into account the porosity and amount of sorbed water contained in these rocks. The remanent magnetization was found to be mainly a chemical magnetization acquired during the process of serpentinization whereby iron atoms, released from the silicate structure of the paramagnetic olivine and pyroxene, are oxidized to form ferrimagnetic magnetite. The intensity of both remanent and induced magnetization increases exponentially with serpentinization. However, the remanent magnetization becomes highly unstable as the rock becomes intensely serpentinized. The intensity of magnetization also depends on the original rock composition, mode of occurrance and state of oxidation of the magnetite. Dissert. Abstr.

N70-20021 California Univ., Berkeley.
RELATION OF AURORAL ZONE MICROPULSATIONS TO MAGNETOSPHERIC SUBSTORMS
Robert Lloyd McPherron (Ph.D. Thesis) 1968 338 p
Avail: Univ. Microfilms: HC $15.30/Microfilm $4.35 Order No. 69-10340

Results presented are used to generalize the models of the auroral and magnetic substorms to include micropulsations occurring in the auroral zone in the night side of the earth. The speculative extrapolation of this generalized model into the magnetosphere suggests that micropulsations play a fundamental role in the explanation of auroral phenomena. Typical characteristics of magnetic substorms are described. These include the durations of the various phases of the substorm and the separation of successive expansions. Magnetic substorms are shown to have a growth phase preceding the expansion. Micropulsations are characterized by a number of different properties, including their amplitude envelope, wave form, Fourier spectra, dynamic spectra, diurnal occurrence, and correlations with other phenomena. Dissert. Abstr.

N70-20026# California Univ., Livermore. Lawrence Radiation Lab.
RESONANT EFFECTS IN THE TIDES IN A NUMERICAL MODEL OF THE ATMOSPHERE
John W. Hardy 2 Jun. 1969 15 p refs
(UCRL-50674) Avail: CFSTI

Both the diurnal and the semidiurnal components of the traveling wave component of the tides in a numerical model of the atmosphere are shown to have resonant peaks in amplitude. The relative sizes of these amplitudes, an historical problem for the atmosphere, is explained by the relative closeness of the excitation periods for each of these peaks to the excitation period of 24 hr. The two components are also shown to have periods differing from those expected from linear theory. Thus, in the model, nonlinear effects are shown to be significant. Author (NSA)

N70-20057 Texas A&M Univ., College Station.
THE MISSISSIPPI RIVER OUTFLOW, ITS SEASONAL VARIATIONS AND ITS SURFACE CHARACTERISTICS
Don Walsh (Ph.D. Thesis) 1968 238 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-8515

This investigation provides a tentative description of mean seasonal and monthly outflow patterns together with an analysis of the factors that shape them. Pertinent historical and contempory data are limited and this effort is only a first approximation of actual conditions. It is shown that averaging of several years' data can provide acceptable mean values of the pertinent properties such as river outflow, wind field, and sea surface temperatures. River discharge is the dominant influence for variation of the outflow pattern and its surface characteristics. Therefore the dynamics of river flow were investigated as a three-step system: flow in a salt wedge estuary, jet discharge at the river mouth, and jet modified by offshore processes. Reasonable relationships were found for the first two steps, however, a mathematical treatment for the third appears intractible at this time. Empirical data was used to describe this step. The mean patterns showed cold river water veering towards the west under influence of prevailing winds and currents. Dissert. Abstr.

N70-20065*# National Aeronautics and Space Administration, Washington, D.C.
PHYSICS OF THE IONOSPHERE AND OF THE MAGNETOSPHERE
In its Rept. to COSPAR, French Space Program Feb. 1970 p 1-22 refs (See N70-20064 08-30)
Avail: CFSTI

Several important aspects of ionospheric and magnetospheric studies are discussed. Of chief interest are the following topics: study of the magnetosphere, study of the ionospheric plasma, study of the ionosphere morphology, mass spectrometry of the high atmosphere, study of the auroral X-rays, study of the South Atlantic anomaly, studies relative to the propagation of waves over long distances, and studies relative to the Doppler effect in back-diffusion and for ionization gradients. Author

N70-20148# Naval Oceanographic Office, Washington, D.C. Marine Sciences Dept.
MONTHLY CHARTS OF MEAN, MINIMUM, AND MAXIMUM SEA SURFACE TEMPERATURE OF THE NORTH PACIFIC OCEAN
Paul E. LaViolette and Sandra E. Seim 1969 64 p
(AD-698125; NOO-SP-123) Avail: CFSTI CSCL 8/10

The charts, based on ship injection temperature data, show the monthly mean, minimum, and maximum sea surface temperatures for the Pacific Ocean from 20 degrees S. (except east of 170 degrees W. where temperatures begin at 10 degrees S.) to 66 degrees N. The data are numerous in all but the equatorial portion of the area, and during the winter in the Bering Sea and Sea of Okhotsk. Upwelling along the coast of the continents is also evident from the charts. The cold waters indicative of such action are graphically displayed along the coasts of California and South America. Because of the large quantity of data involved, these charts, in general, are more definitive than charts of other parameters such as salinity, except where the analysis was based on fewer than 10 observations per 10 degrees quadrangle or in regions where averaging disguises more complex thermal structure. Author (TAB)

N70-20193*# Radiometric Technology, Inc., Cambridge, Mass.
AN ANALYTICAL STUDY OF MEASURED RADIOMETRIC DATA, VOLUME 1
Ronald A. Porter 12 Dec. 1969 383 p refs Sponsored by NASA Prepared for JPL
(Contract JPL-952397)
(NASA-CR-108769) Avail: CFSTI CSCL 08G

A comprehensive analysis has been performed on measured data obtained in the field with microwave radiometers operating at frequencies of 9.5, 16.5 and 94 GHz. This data included observations of sea water, salines, quartz sand and crushed limestone, under a variety of conditions. Apparent temperatures, recorded in the measurements, were converted to brightness temperatures by separating radiations received via the antenna sidelobes and backlobes. Specular and, in some cases, diffuse emissivities were derived from the brightness temperatures. An analysis was then performed on both brightness temperatures and emissivities to determine the angular, polarization, temperature and frequency dependence of the data. In addition, the basic data was correlated with influencing factors such as surface roughness, surface temperature and certain environmental conditions. Comparisons were also made with theoretical data. A set of conclusions and recommendations for further studies are also presented. Author

N70-20194*# Radiometric Technology, Inc., Cambridge, Mass.
AN ANALYTICAL STUDY OF MEASURED RADIOMETRIC DATA, VOLUME 2: SEA WATER DATA
Ronald A. Porter 12 Dec. 1969 81 p Prepared for JPL
(Contracts NAS7-100; JPL-952397)
(NASA-CR-108260) Avail: CFSTI CSCL 08G
For abstract see N70-20193

N70-20195*# Radiometric Technology, Inc., Cambridge, Mass.
AN ANALYTICAL STUDY OF MEASURED RADIOMETRIC DATA, VOLUME 3: SALINES, QUARTZ SAND AND LIMESTONE DATA
Ronald A. Porter 12 Dec. 1969 272 p Prepared for JPL
(Contracts NAS7-100; JPL-952397)
(NASA-CR-108259) Avail: CFSTI CSCL 08G
For abstract see N70-20193.

N70-20234# European Atomic Energy Community, Ispra (Italy). Scientific Data Processing Center.
THE OPTIMIZATION OF MINERAL EXPLORATION INVESTMENTS BY THE COMPUTER PROGRAM EXILE
H. I. de Wolde and J. W. Brinck 1969 56 p refs
(EUR-4403e) Avail: CFSTI

This report describes a method and a computer program for optimizing mineral exploration investments by the following standards: (1) an adequate capitalized reserve, in relation to future annual requirements, must always be accessible; (2) schock effects must be avoided; strong variations must be levelled out smoothly; and (3) expenditures have to be minimal with respect to the first two conditions. Minimal annual discovery rates are calculated together with investment schemes, exploration areas and exploration costs per sq km. Sequential alternatives (levelled) are proposed. The combined results may be obtained in graphical form also. Author

N70-20247# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. GEOGRAPHIC SOCIETY. NEW PROBLEMS AND METHODS OF CARTOGRAPHY (SELECTED ARTICLES)
N. A. Loseva and A. Pavlov Dec. 1968 24 p Transl. into ENGLISH from Izd-Vo Nauka, Leningrad, 1967 p 25-39
(AD-686229; FTD-HT-23-654-68) Avail: CFSTI CSCL 8/2

Contents: Experiments in stereophotogrammetric determination of depths and surveying underwater relief in shallow seas; and Use of Chebyshev Polynomials for computing a cartographic projection from a draft grid. TAB

N70-20302# Blume (John A.) and Associates Research Div., San Francisco, Calif.
ENGINEERING INTENSITY SCALE FOR EARTHQUAKES AND OTHER GROUND MOTION
John A. Blume Sep. 1969 22 p refs

(Contract AT(26-1)-99)
(IAB-99-73) Avail: CFSTI

An engineering intensity scale is proposed for earthquakes and for ground motion resulting from nuclear or chemical explosions. It is based upon 5% damped response spectra developed from the ground motion and a standard 10 × 9 matrix with columns representing period bands and rows representing prescribed response velocity levels, S(v). Acceleration or relative displacement can also be readily assigned with the use of 4 way logarithmic paper. The E1 scale can be reported by period column as 9-digit, 3-digit, or 1-digit numbers, or by all three in a standard format. The more digits reported, the greater the amount of information on the period bands. The advantages over existing scales are many, including ratings that are directly informative and useful in damage estimations. The ratings are made objectively, and have period identification lacking in other scales. Some examples of E1 ratings are provided. Author (NSA)

N70-20367*# National Aeronautics and Space Administration, Huntsville, Ala.
A COLLECTION OF LOWER THERMOSPHERIC (100 TO 300 km ALTITUDE) CHEMICAL COMPOSITION, TEMPERATURE, AND MASS DENSITY DATA
Don K. Weidner and Michael T. Calloway 6 Feb. 1970 104 p refs
(NASA-TM-X-53994) Avail: CFSTI CSCL 04A

Atmospheric data was obtained by various investigators from 38 rocket-probe flights and two satellite-borne absorption spectrometers. The data sample is by no means complete but should provide valuable inputs to studies concerning the structure and variability of the atmosphere. Atmospheric temperature, mass density, and constituent number densities of N2, O2, O, He, and H as calculated from the Modified Jacchia Model Atmosphere, 1967, for the conditions of a particular observation are tabulated from 120 to 1,000 km for most of the observations. These data should also provide valuable inputs to various studies. In using these data, however, the investigator should consider the limitations of the Model Atmosphere. Author

N70-20444*# Illinois Univ., Urbana. Aeronomy Lab.
PRODUCTION AND LOSS OF O(1D) IN THE NIGHTTIME F REGION
Jeffry M. Forbes 1 Jan. 1970 112 p refs
(Grant NGR-14-005-013)
(NASA-CR-108932; Rept-34) Avail: CFSTI CSCL 04A

The production and loss of atomic oxygen in the 1D state, O(1D), in the nighttime F region is studied. Quenching of O(1D) is studied in detail, and is concluded to be an important mechanism in the OI(6300A) night airglow. In addition, the dissociative recombination of O2(+) is found to yield .12 + or − .06 O(1D) atoms per recombination. This result is accomplished by comparing theoretical calculations of the OI(6300A) night airglow vertical volume emission rate with ground-based photometer observations of OI(6300A). The experimental program is also described, and methods of data analysis are presented. Author

N70-20446*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
A FORTRAN 4 PROGRAM FOR TWO-DIMENSIONAL AUTOCORRELATION ANALYSIS OF GEOLOGIC AND REMOTELY-SENSED DATA
W. B. Hempkins 11 Feb. 1970 59 p refs
(Grant NGR-14-007-027)
(NASA-CR-104213; Rept-21) Avail: CFSTI CSCL 08F

The mathematical development and logic for computing a two-dimensional autocorrelation analysis of mapped data is given. Examples of usage of this type of analysis for studying mapped structures and testing statistical properties of trend surface maps and their residual maps are given. A FORTRAN IV computer program for the IBM OS 360/50 is listed. Operating instructions, sample data, and specimen output are also given in detail. Author

N70-20494# Army Foreign Science and Technology Center, Washington, D.C.
USE OF AERIAL METHODS IN LANDSCAPE STUDIES
S. V. Viktorov 21 Oct. 1969 408 p refs Transl. into ENGLISH from the Russian
(AD-698170; FSTC-HT-23-1101-68) Avail: CFSTI CSCL 8/2

The collection of articles covers a wide range of problems: The use of aerial methods in the tundra, taiga, steppe, and sandy deserts; the possibilities of aerial methods for the study of regional characteristics of landscapes; and the applications of aerial photography for large-scale mapping. Author (TAB)

N70-20610# Bureau of Mines, Washington, D.C.
SLOPE STABILITY ANALYSIS BY THE FINITE ELEMENT STRESS ANALYSIS AND LIMITING EQUILIBRIUM METHOD
Fun-Den Wang and Meng-Cherng Sun Jan. 1970 19 p refs
(BM-RI-7341) Avail: Issuing Activity

A new approach for evaluating pit slope stability by the limiting equilibrium method was developed. The finite element method of plane strain analysis is used to find the stress field of the pit slope structure. This stress field is then used to find the normal and shear stresses along a potential failure surface. The normal stresses are used with the Coulomb equation to calculate the shear resistance. The shear stresses are integrated to determine the total driving force. The factor of safety is evaluated from the ratio of the resisting force to the driving force along a failure surface, and is found to be affected by the elastic material properties, modulus of elasticity, and Poisson's ratio. Author

N70-20585*# Stanford Research Inst., Menlo Park, Calif.
LIDAR OBSERVATIONS IN RELATION TO THE ATMOSPHERIC WINDS ALOFT
W. Viezee, J. Oblsnes, and R. M. Endlich Jan. 1970 37 p refs
(Contract NAS8-21117)
(NASA-CR-61318) Avail: CFSTI CSCL 04A

Lidar (laser radar) observations of the visually clear troposphere between 6 and 14 km are compared with data from simultaneous rawinsonde and Jimsphere ascents for the purpose of exploring possible relationships between lidar echoes and the atmospheric winds aloft. Because of its low intensity, the backscattered laser signal was monitored by means of a pulse-counting technique. The data indicate that the level of maximum wind speed corresponds to a level of relative increase in the optical density of the atmosphere as detected by the lidar. For the data examined, this level lies either at the tropopause or under the tropopause near layers of relative stability as shown by the temperature profile. The increase in optical density represents an increase in the concentration of particulate matter. Since its level corresponds to the average altitude for cirrus clouds, it is believed that the increase in particle density detected by the lidar is due to advection and/or formation of ice crystals near the level of maximum wind. It is concluded that the lidar-observed turbidity profile of the upper troposphere may be of value in inferring wind shear or layers of maximum wind speed, particularly in terms of extending information acquired by conventional means to other times. Author

N70-20604# Coast Guard Academy, New London, Conn.
PROCEEDINGS OF THE FIRST USCG NATIONAL DATA BUOY SYSTEMS SCIENTIFIC ADVISORY MEETING, 12-14 May 1969
11 Jul. 1969 181 p
(AD-695501) Avail: CFSTI CSCL 13/10

The U. S. Coast Guard National Data Buoy Development Project (NDBDP) is currently conducting planning studies preparatory to undertaking research, development, testing, and evaluation of all aspects of National Data Buoy Systems (NDBS) capable of satisfying national requirements for collection of marine atmospheric and oceanographic environmental data. Four broad classes of data requirements have been identified: Operational, Deep Ocean; Operational, Coastal North America; Operational, Estuaries and Great Lakes; and Research. Author (TAB)

N70-20852*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
MAGNETOSPHERIC SUBSTORM EFFECTS ON ENERGETIC ELECTRONS IN THE OUTER VAN ALLEN BELT (SUMMARY OF TECHNICAL REPORT CR-137)
T. W. Lezniak and J. R. Winckler Apr. 1969 11 p refs
(Grant NGL-24-005-008)
(NASA-CR-108993; CR-137) Avail: CFSTI CSCL 08N

Empirical evidence is discussed for a substorm-associated acceleration process to account for the large electron increases seen in the post-midnight sector of the outer radiation belt at sychronous orbit by ATS-1. The increases shown have recurrent fluctuations in intensity in the three given channels, the largest fluctuations occur just after local midnight and decrease in intensity as local time increases, and the largest transient increases are observed for the 50 to 150 keV electrons. The total geomagnetic field strength at the spacecraft and the angle between the geomagnetic and the north pointing vector are shown. Author

N70-20853*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
DRIFT OF NONINTERACTING CHARGED PARTICLES IN A SIMPLE GEOMAGNETIC FIELD
M. A. Schield Oct. 1969 29 p refs Presented at the Rice Conf. on Elec. Fields in the Magnetosphere, Houston, Tex., 10-13 Mar. 1969
(Contract NAS5-9196; Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-108968; Rept-69-54) Avail: CFSTI CSCL 08N

The effect of a uniform electric field upon the drift paths of noninteracting charged particles, mirroring equatorially in a rotating magnetic dipole-field, is quantitatively analyzed. The points of zero drift velocity are determined for all conditions and the particle drift paths are illustrated for various ratios. The corotation field can produce significant dawn-dusk asymmetries in the forbidden regions of charge separation and in the storm-time ring current assuming the magentic field lines are equipotentials within the body of the magnetosphere. Author

N70-20867# Directorate of Scientific Information Service, Ottawa (Ontario).
SOURCE OF MANGANESE IN THE PACIFIC OCEAN FLOOR SEDIMENTS
V. I. Chainiko Oct. 1969 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 187, no. 4, 1969 p 909-911
(AD-695326) Avail: CFSTI CSCL 8/7

The origin of the increased concentrations of manganese in the oceanic sediments is a question that has been attracting the attention of research workers since the times of the first Challenger expedition. The samples from the floor sediments of the northeastern Pacific Ocean are mainly red clay, with an 0.5-0.7 per cent content of manganese oxide. Author (TAB)

N70-20753*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
A LATITUDE COMPARISON OF N2 DENSITY MEASUREMENTS BY MASS SPECTROMETER
E. J. Schaefer Dec. 1969 28 p refs
(Grant NGR-23-005-360; ORA Proj. 03400)
(NASA-CR-109093; Rept-03400-1-5) Avail: CFSTI CSCL 04A

Ambient N2 densities at altitudes between 100 and 200 km derived from the data of three nighttime mass spectrometer rocket flights at different latitudes are compared. The three flights occurred under nearly identical solar and geomagnetic conditions. The temperate and northern N2 densities are compared with results obtained by other experimenters and found to be in good agreement. A density gradient, increasing with increasing north latitude is a principal result. The southern tropic N2 density is found to be about 10% of that above Wallops Island at an altitude of 200 km. Satellite data are shown to support the results qualitatively. The possibility that the low tropic density is due in part to instrumental error is considered. It is concluded that the weight of experimental evidence supports the validity of the results. The extremely low temperatures around 110 km which are deduced from the tropic density results are shown to be compatible with mesopause temperatures derived from a grenade experiment at nearly the same latitude. Author

N70-20778# Pittsburgh Univ., Pa.
THEORETICAL AND EXPERIMENTAL STUDIES OF QUESTIONS DEVELOPED BY A STUDY OF AIR FLUORESCENCE AS A METHOD OF DETECTING NUCLEAR EXPLOSIONS Final Report
Thomas M. Donahue Nov. 1969 7 p
(Contract Nonr-624(17); ARPA Order 215)
(AD-697693) Avail: CFSTI CSCL 4/1

Energy loss processes for electrons in atmospheric gases have been studied in the laboratory and in the aurora with sounding rockets. Results include cross sections for dissociative excitation of species such as O2 and CO2 and excitation and ionization cross sections for N2 and O2. Author (TAB)

N70-20894*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
AN INVESTIGATION OF MASS DISPERSION IN ELECTRIC IMPULSIVE FIELDS
H. M. Luther 20 Feb. 1970 66 p refs
(Grant NGL-39-009-032)
(NASA-CR-109083; SR-349) Avail: CFSTI CSCL 04A

Ion energy gains and losses in planar and cylindrical impulsive fields are investigated theoretically. Ion energy analyzers suitable for analyzing energies of ions emerging from impulsive electric fields are discussed theoretically and experimental results are presented. Ion energy analyzers studied include those based on a simple retarding field, the retarding field in combination with an energy bandpass filter, and cylindrical as well as spherical sector fields. Applications of the mass dispersive properties of the impulsive electric field to mass spectrometry are discussed, and the resolving power as a function of the impulsive field strength and the initial ion energy spread of the ions in a beam incident upon the impulsive field is worked out. Complete impulsive mass spectrometers are described and experimental results are presented. Possible uses of the impulsive mass spectrometer are suggested. Author

N70-20901*# General Oceanology, Inc., Cambridge, Mass.
GRAVITY GRADIENT PRELIMINARY INVESTIGATIONS FINAL REPORT ON EXHIBIT "B," PART 1: FIELD GRAVITY SURVEY, PART 2: LUNAR MASCON GRAVITY GRADIENTS
Lloyd G. D. Thompson, Mark H. Houston, and Daniel A. Rankin 31 Jan. 1970 99 p refs
(Contract NAS9-9200)
(NASA-CR-108294; GO-13) Avail: CFSTI CSCL 08E

By a special surveying technique, horizontal gravity gradients as well as conventional gravity anomalies were obtained over a 5 km by 5 km area of the high desert south of Brothers, Oregon. Comparison of the two methods showed that the gradient technique appeared to be easier and more efficient both in data acquisition and data processing, but direct interpretation of the data was more difficult. Vertical gravity gradients calculated from the gravity anomalies will provide reference and control values for future tests with a vertical gravity gradiometer. A preliminary assessment illustrates the application and usefulness of gravity gradients for the detection and interpretation of lunar Mascons (mass concentrations or anomalies). Comparison of the Mascon gravity and gravity gradient signatures with those for simple geologic models shows that the Mascons are most probably near-surface disc- or plate-like structures of varying thickness. Author

N70-20921*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
HIGH ALTITUDE RADIATION MEASUREMENTS Quarterly Report, 1 Jul.-30 Sep. 1969
Fred L. Bartman Dec. 1969 19 p refs
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-109090; Rept-05863-27-P) Avail: CFSTI CSCL 04A

Problems in the analysis of interferometer data from the 20 November 1968 balloon flight were solved. High resolution measurements of the 15 micrometer CO2 band with the 1.8 meter Jarrell Ash spectrometer were obtained; modifications to the instrument for this purpose are described which involved entrance and exit optics, and a connecting flange. A literature survey regarding the distribution of CO2 in the earth's atmosphere is continuing and selected references are included. Author

N70-20948# Geological Survey, Washington, D.C.
THE EFFECT OF TWO-DIMENSIONAL TOPOGRAPHY ON SUPERFICIAL THERMAL GRADIENTS
Arthur H. Lachenbruch 1969 105 p refs
(AD-698156; BULL-1203-E) Avail: CFSTI CSCL 8/7

The Jeffreys-Bullard theory of the topographic disturbance to geothermal gradients is only approximate because it neglects the effects of lateral heat loss through sloping surfaces. It cannot be applied with confidence where the height of the relief features is large relative to their horizontal distance from the station and to the depth of the measurement points. In an important special case, the measurement depth is small relative to the distance to the relief, and the gradient anomaly can be approximated by the value applicable at zero depth. To investigate this case, an exact solution was obtained for the steady heat flux through an inclined plane of arbitrary height and slope angle. The effects of slopes of fairly general (two-dimensional)form can be approximated by identifying them with their equivalent plane slopes--the plane slopes which yield the same Jeffreys approximation at the station. The results are valid at points arbitrarily close to slopes of any height or inclination. Author (TAB)

N70-21019# Osservatorio Geofisico Sperimentale, Trieste (Italy).
CAMBRIDGE PENDULUM MEASUREMENTS OF GRAVITY DIFFERENCES ON THE WEST PACIFIC CALIBRATION LINE Final Scientific Report
B. C. Browne and T. Honkasalo 5 May 1969 17 p refs
(Contract F61052-67-C-0071)
(AD-697407; AFCRL-69-0394) Avail: CFSTI CSCL 8/5

The paper is a final report on the measurements taken in 1967 with the Cambridge Pendulum Apparatus along the West Pacific Calibration Line. TAB

N70-21033# Akademiya Nauk URSR, Kiev.
THE POSSIBILITIES OF INVARIANT MEASUREMENTS IN AERIAL ELECTRIC GEOPHYSICAL PROSPECTING
Ye. M. Yershov and B. S. Svetov *In its* The Selection and Transmission of Inform., No. 17 1968 p 42-54 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

The dependence of the imaginary component of the field of horizontal and vertical magnetic dipoles on the variation in their coordinates and the observation point in a horizontally stratified structure is studied. The practical invariance of its modulus is shown with respect to a change in the configuration of the source-field receiver-ground system. Transl. by H.W.

N70-21034# Akademiya Nauk URSR, Kiev.
APPLICATION OF TRANSIENT FIELDS IN INDUCTIVE ELECTRIC GEOPHYSICAL PROSPECTING
F. M. Kamenetskiy *In its* The Selection and Transmission of Inform., No. 17 1968 p 55-67 refs In RUSSIAN (See N70-21030 08-09)
Avail: CFSTI

The transient response method is based on collecting solutions of primal problems about the transient magnetic field of an undergrounded loop and a magnetic dipole, in which the current varies according to the principle of a Heaviside function for various geoelectric profiles. The method is compared with other inductive methods used in direct exploration of highly conductive ore deposits. The basic concepts which characterize the method are formulated and the area of its applicability in solving problems of mining geophysics is outlined. Transl. by R.B.

N70-21061 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO REGIONAL DISTRIBUTION OF TRANSFER OF ATMOSPHERIC PARAMETERS OVER THE EQUATOR
D. Henning 28 Nov. 1969 39 p refs Transl. into ENGLISH from Beitr. Physik. Atmos. (Brunswick), no. 41, 1968 p 289-335 *In* ENGLISH and partly in GERMAN
(NLL-M-7883-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .6 NLL photocopy coupons

Equatorial weather station data were analyzed to determine the annual mean total of relative angular momentum transfer across the equator and to evaluate the dependence of this process on regional, seasonal, and height differences. Findings include: (1) Meridional total transfer of relative angular momentum across the equator takes place mainly in the upper troposphere. Over the Asian and African region, the process in the upper troposphere has a seasonal rhythm with maximum transfer to the summer hemisphere, minimum transfer to the winter hemisphere. (2) Intense transfer in the lower troposphere is due to the drift contribution. Except over the Pacific, high values in the upper troposphere are produced by an interaction of drift and eddy terms. (3) At the majority of the stations, the annual mean total transfer always has the same sign. In the long-term mean, the northern hemisphere is a sink of relative angular momentum and the southern hemisphere a source. D.L.G.

N70-21084# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
ACOUSTIC WAVES IN THE IONOSPHERE
D. P. Hoult 1 Oct. 1969 25 p refs
(Contract DAHC04-68-0034; Grant NSF GP-5611)
(AD-697713; SR-339) Avail: CFSTI CSCL 4/1

Acoustic wave characteristics in the upper atmosphere are deduced from temporal and spatial electron density variations obtained with the Arecibo back-scatter sounder. A theory is developed which relates the observed wave characteristics to the power spectrum of the wave sources. Author (TAB)

N70-21088# Woods Hole Oceanographic Institution, Mass.
R/V CHAIN CRUISE NO. 82: NORTH ATLANTIC OCEAN AND MEDITERRANEAN SEA Summary Cruise Report, 10 May-15 Sep. 1969
W. M. Dunkle, ed. Jun. 1969 207 p
(Contracts Nonr-4029(00); N00014-66-C-0241)
(AD-697578; WHOI-REF-69-28) Avail: CFSTI CSCL 8/10

The report contains a summary by the Chief Scientists for each of their legs and charts for R/V CHAIN Cruise 82 in the North Atlantic Ocean and Mediterranean Sea with a major survey on the mid-Atlantic Ridge. There are 180 charts plotted on a Mercator Projection (scale 1 longitude equals 4 inches) showing the track of the entire cruise except during special surveys. All types of observations made during the cruise are noted by suitable symbols or legends along the ship's track. The locations of special surveys are shown on Charts I - II. Chart III shows special observations made during the mid-Atlantic survey. Also included are total intensity magnetic field measurements (in gammas) which are shown along track opposite the bathymetry. There are 11 pages

listing information gathered at each of the 60 study locations. Soundings are read at each break in slope and every 10 minutes. Soundings are based on a sound velocity of 800 fathoms/second and are corrected only for the depth of ship's transducer. Author (TAB)

N70-21089*# Allied Research Associates, Inc., Concord, Mass. Geophysics and Aerospace Div.
MANAGEMENT, PROCESSING AND DISSEMINATION OF SENSORY DATA FOR THE EARTH RESOURCE TECHNOLOGY SATELLITE
Earl S. Merritt, Walter C. Ahlin, Leon Goldshlak, Jacques J. O. Palgen, Romeo R. Sabatini et al Dec. 1969 135 p
(Contract NAS5-10343)
(NASA-CR-109081; Rept-9G45-43; TR-11) Avail: CFSTI CSCL 09B

The elements of a data center for the management, processing and dissemination of photographic products generated by the Earth Resource Technology Satellite (ERTS) is specified. In addition to the specification of functional elements, this study examines and provides specification of: data rates and data flow time lines; facility, equipment and material requirements for a one-year operation over the Continental United States; and some preliminary analyses of photographic processing and materials that can influence picture element accuracies. A plan is presented for the further implementation steps necessary to provide an operating Data Center in time for an ERTS launch in early 1972. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-19708*# Volt Information Sciences, Inc., Washington, D.C.
DIFFRACTION THEORY OF SHADOW KNIFE AND SLIT PHOTOMETRIC METHODS
L. A. Vasilyev et al Greenbelt, Md. NASA. Goddard Space Flight Center 27 Jun. 1969 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 186, no. 1, 1969 p 70–72
(Contract NAS5-12487)
(NASA-CR-108245; ST-PHM-GO-10850) Avail: CFSTI CSCL 14B

In this paper the diffraction theory of shadow knife and slit photometric methods are considered. The basis of measurements conducted by shadow photometric methods lies in the assumption of linear dependence between the deflection angle of the ray and the plane illumination of shadow instrument's image. This dependence follows from the geometrical scheme of the methods. The distribution of the illumination is found in the diffraction pattern and a dependence is established between the diffraction error and the conditions of measurements. Author

N70-19727# Boeing Co., Renton, Wash. Commercial Airplane Div.
AN ERROR ANALYSIS OF THE IMPEDANCE TUBE METHOD
Stuart H. Eaton 11 Dec. 1969 53 p refs
(D6-22596TN) Avail: CFSTI

The Acoustic Impedance Tube is studied as a convenient method for determining acoustic impedance of sample materials at normal incidence over a wide range of frequencies and sound pressure levels. A constant length interferometer, which has proved sufficiently accurate for many practical problems in sound absorbing materials are used is reviewed especially where only the absorption coefficient is required. The purpose of this note is to determine the sources of experimental error, and to assess their contributions to the overall accuracy in the final results, through manipulations of the working equations. Suggestions are made for target accuracies, which have compatible contributions to the overall error or uncertainty. Author

N70-19739# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
PROCEEDINGS OF A SEMINAR ON FUTURE DEVELOPMENT OF AUTOMATIC BUBBLE CHAMBER FILM MEASUREMENT
I. Butterworth and C. M. Fisher Jun. 1969 53 p Conf. held at Clifton, Engl., 13 Oct. 1968
(RHEL/R-183; CONF-681068) Avail: CFSTI

The following papers are presented, with discussions: Present status of well established measuring devices; PEPR systems; Sweepnik; Sweepnik performance to date; What is right and what is wrong with HPD; Polly systems; Bubble images in the new chambers; Work done by LBCG group at CERN; Precision of optical constants of 12 ft Argonne chamber; Scan-measure system for Gargamelle; and Future work on PEPR. NSA

N70-19808*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN IMPROVED METHOD FOR THIN-FILM THICKNESS MEASUREMENTS
James L. Zurasky and Robert Forsten (Sperry Rand Corp.) 5 Jan. 1970 13 p refs
(NASA-TM-X-53979) Avail: CFSTI CSCL 14B

This report describes an improved method of measuring thin films on metal by interpretation of interference fringes. The essential characteristic of the method is photographing an interference pattern produced by an interferometer; then, this negative is scanned by use of a microdensitometer to determine exact fringe location. Details of the method, expected accuracies, and possible improvements are outlined. Author

N70-19845*# Old Dominion Coll., Norfolk, Va.
AN EXPERIMENTAL STUDY OF A TYPE OF VORTEX SINK RATE SENSORS
Rao V. Arimilli (M.S. Thesis) Aug. 1969 45 p refs
(Grant NGL-47-003-007)
(NASA-CR-86902) Avail: CFSTI CSCL 17G

The flow field in the sink region of a vortex sink rate sensor was studied. Using two probes for the total and static pressure measurements, data was collected for two flow rates, various rate of rotation and at various points in the sink region of the flow. For the sensor (coupler inside diameter 5.0 inches and height 0.50 inches) with slenderness parameter of unity, four conclusions were drawn. At a given location in the flow field the magnitude of the tangential component of velocity increased for decreased flow rates. Viscous core did exist in the sink flow and outside of it the tangential component of velocity was negligibly small. Within the viscous core the tangential component of velocity increased in a general manner with increased rates of rotation. The maximum of the tangential component of velocity occurred within the entrance region to the sink tube. Author

N70-19848# Joint Publications Research Service, Washington, D.C.
MEASUREMENT EQUIPMENT FOR AERIAL ELECTRICAL PROSPECTING USING THE NATURAL ELECTROMAGNETIC FIELDS METHOD

V. D. Gelfand et al 23 Jan. 1970 10 p refs Transl. into ENGLISH from Geofiz. Apparatura (Moscow), no. 39, 1969 p 25–33
(JPRS-49678) Avail: CFSTI

Natural electromagnetic field equipment is described with particular attention given to the optimum discrimination of the useful signal. The use of three field detectors and three measuring channels, whose thermal noise is statistically independent, makes it possible to apply the cross correlation method, which is optimum from the point of view of noise immunity. The basis for this equipment is the relative method for measuring the averaged characteristics of signals at the output of two inductive field detectors whose axes are mutually perpendicular in the vertical plane. The basic measured parameter ratios are: (1) dispersions of signals induced in the field detectors, (2) the real cross correlation coefficient between signals induced in the receiving loops and the signal autocorrelation coefficient for one of the detectors, (3) the imaginary cross correlation coefficient of signals to the autocorrelation coefficient of one of them, and (4) the imaginary cross correlation coefficient beteen two signals and the real coefficient. D.L.G.

N70-19863# Electrotechnical Lab., Tokyo (Japan).
HIGH VACUUM STANDARD
Katsuya Nakayama May 1969 102 p refs In JAPANESE; ENGLISH summary *Its* Res. No. 701
Avail: CFSTI

Research to establish a reliable standard for calibrating high vacuum gages is described. The fundamental considerations are made both on the concept of pressure in high vacuum systems and on the sources of error in the known methods for calibrating vacuum gages. As a result, the gage calibration system by means of a large high precision McLeod gage is adopted as the high vacuum standard, provided that no gas flow exists in the gage manifold for calibration. Design and construction details are given with discussion of a source of irreproducibility in measuring low pressures with a McLeod gage. Development of the ionization gage with a specified design for the secondary standard is included. Accuracy of the secondary standard ionization gages calibrated by means of this standard system is given to be about 2%. Author

N70-19864 National Lending Library for Science and Technology, Boston Spa (England).
A NEW INSTRUMENT FOR MEASURING DEW POINTS
C. Bachem et al 28 Nov. 1969 6 p Transl. into ENGLISH from Meteorol. Rundschau (Heidelberg), v. 20, no. 3, 1967 p 67–68
(NLL-M-7876-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A newly constructed dew point meter with heated electrolytic sensor can make continuous measurements of dew points down to below −40 C, at relative humidities down to 10%, to within + or − 0.2 C. One improvement is that the electrolytic sensor is heated not by the current through it but by the actual gas to be measured, which is heated automatically by an amplifier controlled by the sensor conductance. The sensor temperature, which depends on vapour pressure, is set to within + or − 0.1 C with only a small time lag. The equilibrium temperature is practically independent of thermal effects from the environment. Author

N70-19942 National Lending Library for Science and Technology, Boston Spa (England).
ON THE PROBLEM OF THE INTERPRETATION OF MEASUREMENTS OF OUTGOING RADIATION MADE BY RADIOMETERS WITH AN UNRESTRICTED FIELD OF VISION ON METEOROLOGICAL SATELLITES OF THE EARTH
K. Ja. Vinnikov 28 Nov. 1969 17 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 228, 1968 p 137–153 In ENGLISH; partly in RUSSIAN Presented at the 6th Interdepartmental Conf. on Actinometry and Atmospheric Optics
(NLL-M-7853-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

A scheme is presented for converting radiation fluxes measured by wide-sector radiometers at the level of a meteorological satellite to values of the outgoing radiation at the level of the conventional upper boundary of the atmosphere. It is shown that wide-angle radiometers with an unrestricted field of vision on satellites at the above heights detect 74, 63 and 55% of the variance of the field of outgoing radiation. Consideration is given an optimal variant of the method for converting single measurements by wide-sector radiometers to values of the outgoing radiation averaged over the area of a circle of any radius. He calculates reduction coefficients and the standard errors of the reduced quantities. The method developed makes it possible to solve the problem of the interpretation of measurements made by radiometers with different spatial resolutions. Author

N70-19943# California Univ., Berkeley. Lawrence Radiation Lab.
WIRE SPARK CHAMBERS IN SPECTROMETER EXPERIMENTS
Victor Perez-Mendez, Johnie M. Sperinde and Albert W. Stetz 15 Apr. 1969 8 p refs Presented at Intern. Conf. on Filmless Spark and Streamer Chambers, Dubna, USSR
(Contract W-7405-eng-48)
(UCRL-18846; CONF-690433-1) Avail: CFSTI

Wire spark chambers with magnetostrictive delay line readout are described. The design and electrical characteristics of these chambers and the use of on-line small computers are discussed. It is pointed out that experimental situations where the wire spark chambers are found most useful are those in which there is a possibility of measuring the vector momentum very precisely, and its mass by Cherenkov counters, allowing a selection of the desired reaction from a large number of competing events. NSA

N70-19963# Los Alamos Scientific Lab., N. Mex.
CALIBRATION OF A TWO-STAGE AIR SAMPLER
Harry J. Ettinger and George W. Royer Aug. 1969 7 p refs
(Contract W-7405-eng-36)
(LA-4234) Avail: CFSTI

A two-stage sampler consisting of a nylon cyclone, followed by a glass fiber filter was calibrated using monodisperse test aerosols. Cyclone efficiency, as a function of sampling flow rate, and aerosol aerodynamic diameter were determined. At a flow rate of 1.7 liters/min, this sampler provides a good estimate of respirable dust concentration. Author (NSA)

N70-20064# Rocketdyne, Canoga Park, Calif. Research Div.
VECTOR THRUST LOAD CELL FEASIBILITY STUDY Final Report, Apr. 1968-Jun. 1969
R. W. Postma Dec. 1969 114 p refs
(Contract F40600-68-C-0004)
(AD-697953; R-7819-F; AEDC-TR-69-233) Avail: CFSTI CSCL 14/2

This report describes the results of a research study and analysis of a 6-component force balance for testing rocket engines. The balance is essentially a self-contained, semi-portable structure of strain-gaged force links attached at the forward end of the rocket motor. The physical size of a balance which would cover the thrust range of 1000 lbf to 10,000 lbf is 15 inches diameter, 7-1/2 inches overall height, and 225 lb weight. Three geometrical arrangements of force links were considered and one of these using 3 axial force links and 3 side force links was analyzed in detail. The analysis includes force vector resolution, first order interactions arising from structural redundancy and force link misalignment, and second order interactions resulting from distortion of the balance under load. Calibration methods and theory relating to data reduction are also discussed. The study includes an analysis of propellant couplings which compensate for the effects of links and the attached propellant coupling is intended to simplify installation, alignment, and calibration procedures for 6-component rocket engine testing. Author (TAB)

N70-20217# Brookhaven National Lab., Upton, N.Y. Health Physics Div.

FACTORS AFFECTING PULSE SIZE IN SEALED TISSUE-EQUIVALENT COUNTERS

John W. Baum, Ray C. Woodcock, and Alan V. Kuehner [1969] 15 p refs Presented at 2d Intern. Conf. on Accelerator Dosimetry and Experience, Stanford, Calif., 5–7 Nov. 1969 Sponsored by AEC

(BNL-14063; CONF-691101-3) Avail: CFSTI

Changes in pulse size caused by small pressure increases due to outgassing were compared to changes induced by adding equal amounts of air or counting gas to a chamber with an initial fill of 20 mm Hg of TE gas. The results showed exponential decreases in pulse size for few mm Hg increases of pressure. The outgas products decreased pulse size to 50% of its initial value in about seven days. Mass spectrographic analyses revealed the presence of water vapor in the outgas products in addition to N2 and O2. Major improvements were demonstrated by use of P2O5 to continuously remove water vapor from sealed detectors. Pulse size decreased to 50% of initial values in 112 days in this test. It was concluded that water vapor is the principal source of pulse size variation with time in a sealed TE detector and that its undesirable effects can be reduced to an acceptable point by use of a suitable desiccant such as P2O5. Outgassing of all chamber materials for several months at about 70 C before, during, or after construction should achieve the same end. Author (NSA)

N70-20256# Scientific Research Atomic Reactor Inst., Melekess (USSR).

DEVELOPMENT OF THE METHODS AND RECORDING APPARATUS FOR THE EXPERIMENTAL DETERMINATION OF THE ENERGY RELEASE IN THE CHANNELS OF HIGH-FLUX RESEARCH REACTORS [RAZRABOTKA SPOSOBOV I REGISTRIPUYUSHCHEI APPARATURY DLYA EKSPERIMENTALNOGO OPREDELENIYA ENERGOVYDELENII V KANALAKH VYSOKOPOTOCHNYKH]

V. A. Neveroy, B. V. Samsonov, and V. A. Tsykanov 1968 106 p refs In RUSSIAN

(SRARI-P-19) Avail: CFSTI

The description of new calorimetric device construction and recording systems of sample temperature change and reactor power in time is reported. The method analysis of some known and newly developed calorimetric methods of energy-release measurement in reactor channels is shown. The exact estimate of measurement errors has been obtained for a number of known methods on the base of energy release measurement in some channels of SM-2 reactor with help of one calorimetric device. The measurement results of energy release levels in reactor channels are given for different moments after reactor shutdown by safety rod tripping. Author (NSA)

N70-20287# Institute of Nuclear Research, Warsaw (Poland).

LOGARITHMIC RATEMETER WITH SCINTILLATION HEAD FOR GAMMA, BETA, AND N RADIATION MEASUREMENTS IN REACTOR DOSIMETRY SYSTEMS

A. Ostrovskii 1969 14 p refs In RUSSIAN

(INR-P-1074) Avail: CFSTI

An instrument designed for gamma, beta, and neutron radiation measurements in a reactor environment is described. The counting rate of pulses coming from scintillation detectors is measured in logarithmic scale, in two ranges: 0.1 to 10,000 p/s and 1 to 100,000 p/s. The scintillation detector allows for operation at long distances from the measuring panel. All measuring circuits including the pulse amplifier, discriminator, pulse forming circuit for log ratemeter, two log ratemeter assemblies (diode pumps), dc amplifier, trip circuit, stabilized H. T. supply, and low voltage stabilizers for the measuring circuits, are situated in the main panel. The instrument is fed from ac mains, 220 v, 50 Hz. The circuits are described and data on the instrument's properties are given. Author (NSA)

N70-20292# Central Lab. for Radiological Protection, Warsaw (Poland).

THERMOLUMINESCENCE READER FOR LOW AND HIGH TEMPERATURE PHOSPHORS

Stanislaw W. Glowacki 1969 22 p refs In POLISH

(CLOR-75/D) Avail: CFSTI

The thermoluminescence reader developed in Central Laboratory for Radiological Protection is described. The reader can be used for low as well as for high temperature phosphors. The instrument makes possible the analog measurement of the glow curve, or the digital measurement of the total amount of light. The maximum sensitivity for CaF2 phosphor is 0.5 mR of exposure dose. Author (NSA)

N70-20303# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

AUTOMATED ULTRASONIC NONDESTRUCTIVE TESTING SYSTEM

R. C. Maxson 5 Nov. 1969 50 p

(Contract W-7405-eng-26)

(Y-1693) Avail: CFSTI

A small, general purpose computer was used to automate an ultrasonic inspection machine designed to evaluate the internal integrity of flat plates and right circular cylinders. Application of the computer extended the capabilities of the basic system to include inspection of free form surfaces of revoluation. The automated system controls the positioning of the ultrasonic probe to maintain the probe perpendicular to and at a constant distance from the part surface. Using the front surface echo as the feedback control parameter, the desired tracking was achieved. Development of the automatic control system has greatly increased the versatility of the inspection device. Author (NSA)

N70-20329# Aerospace Corp., El Segundo, Calif. Lab. Operations.

THICK FILM THERMOCOUPLE GAUGES FOR ROUGHENED MODEL HEAT FLUX MEASUREMENTS, FEB.-MAY 1969

Keith E. Starner and Robert L. Varwig 3 Sep. 1969 31 p refs

(Contract F04701-69-C-0066)

(AD-697962; TR-0066(5240-10)-1; SAMSO-TR-69-359) Avail: CFSTI CSCL 14/2

The study of wall roughness effects on model heat transfer in high Reynolds number shock tunnel flows of a few milliseconds duration requires the use of a rugged, fast-response calorimeter of known surface roughness. Models constructed of continuous thin copper sheeting over a solid insulator substrate with rear thermocouples attached were developed for this purpose. The surface of the copper can be roughened as required and thus forms both an unbroken model surface segment and a heat flux calorimeter. Conditions of heat flux and tunnel test time under which the gauge is useful are shown by analysis. Results from calibration experiments and shock tunnel tests are discussed. Author (TAB)

N70-20338# Sandia Corp., Albuquerque, N. Mex. Advanced Development Div.

GENERAL STUDY OF VERGE ESCAPEMENT PERFORMANCE

J. N. Shinkle Oct. 1969 57 p refs

(SC-RR-69-495) Avail: CFSTI

Various aspects of a study of verge escapements are presented. The study was made primarily in order to define performance of inertially driven verge odometers and velocimeters when these devices are subjected to dynamic environments. A set of defining differential equations is derived and solved numerically for the cases of interest. Variation in performance is determined for the case of a statically applied driving force as geometrical and inertial variations are made in the escapement. It is shown that these devices perform in a manner that is radically different from their performance in a benign environment. Charts are presented which can be used to make the device more useful in quasistatic environments. Charts are also presented which show the generally erratic and unpredictable performance of the verge subjected to a vibratory input. In general, it can be said that a verge escapement is not a very useful device unless it can be isolated from vibrational input driving torques. Author (NSA)

N70-20384*# Harvard Coll. Observatory, Cambridge, Mass.
CALIBRATION CHANGES IN EUV SOLAR SATELLITE INSTRUMENTS
E. M. Reeves and W. H. Parkinson Sep. 1969 31 p refs
(Contract NASw-184)
(NASA-CR-108859; TR-12) Avail: CFSTI CSCL 14B

The problem of absolute photometric calibration in the extreme ultraviolet range with particular reference to a solar satellite instrument is reviewed. The EUV transfer standards, the use of predispersing spectrometers, and polarization effects at near normal incidence are discussed. Changes in preflight calibration associated with the general problems of contamination are given as the background to the main discussion relating to changes in photometric calibration during orbital operation. Conclusions relating to adequate photometric measurements horizontal orbit are drawn, with a short list of the best solar flux measurements for reference. Finally, the importance of rocket flights for photometric calibration of satellite instruments is indicated. Author

N70-20480 National Lending Library for Science and Technology, Boston Spa (England).
ON THE COMPARISON OF THE READINGS OF INERTIAL INSTRUMENTS
R. L. Kagan 28 Nov. 1969 9 p refs Transl. into ENGLISH from Glav. Geof. Obs., T. Vyp. (Leningrad), v. 228, 1968 p 131–136
(NLL-M-7869-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The problem of the differences between the readings of 2 first-order linear instruments with different inertia is considered. Formulae for estimating these differences are derived from the given correlation function of the quantity measured, assuming that this quantity is statistically stationary. The ratio of the mean square difference between synchronous readings of the instruments to the variance of the quantity measured is tabulated for the cases of exponential structure and the two thirds law. In comparing the instruments one can consider the instrument with the smaller time constant to be practically non-inertial only if its time constant is at least 10 to 30 times less than the correlation time scale. Author

N70-20482 National Lending Library for Science and Technology, Boston Spa (England).
DYNAMIC ERRORS OF SOLAR MAGNETOGRAPHS [DINAMICHESKIE OSHIBKI SOLNECHNYKH MAGNITOGRAFOV]
O. V. Nikonov and E. S. Nikonova [1969] 6 p refs Transl. into ENGLISH from Soln. Dannye, (Russian), no. 5, 1969 p 86–90
(NLL-RTS-5568) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

It is shown that in the ordinary conditions of operation of the magnetograph dynamic distortions of the signal can significantly exceed the noise variations. These distortions affect the precision of observations. The results of computation of a transient process for the a triangular burst of the magnetic field, using the general magnetograph arrangement and ordinary correcting elements, are given. Methods are recommended for optimal recording of the magnetic field. Author

N70-20490*# TRW Systems Group, Redondo Beach, Calif.
ANALYSIS OF HOLOGRAMS OF REACTING SPRAYS Final Report
R. F. Wuerker, B. J. Matthews, and B. J. Heckert Jan. 1970 86 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952357)
(NASA-CR-108917; TRW-12299-6001-R0-00) Avail: CFSTI CSCL 14B

Holograms of reacting and non-reacting droplet sprays were reconstructed and photographed for the purpose of evaluation and data reduction. The virtual image reconstruction was accomplished with a pulsed ruby laser and the reference beam optics of the holocamera originally used to record the hologram. A 4 by 5 inch view camera, focused on a preselected plane of interest in the scene volume, photographed the reconstruction on very fine grain film emulsion. These negatives, together with positive prints of the negatives, were subejcted to manual drop size measurements. Drop size data were analyzed and correlations made with empirical mean droplet diameters. Size distributions of the measured droplets were also compared with published experimental data from the literature. Precise holocamera resolution measurements were made using the same recording-reconstruction techniques described for the droplet sprays. These measurements served to help define the smallest droplets which could be resolved and, further, to indicate the effect on resolution of coherent light granularity. Author

N70-20586*# General Radio Co., West Concord, Mass.
RUBIDIUM SPACECRAFT ATOMIC TIMING SYSTEM Final Report
R. W. Frank, J. C. Held, R. A. Mortenson, W. J. Riley, H. P. Stratemeyer, et al 12 Dec. 1969 151 p Prepared for Varian Associates, Palo Alto, Calif.
(Contract NAS5-5425)
(NASA-CR-102193) Avail: CFSTI CSCL 14B

Design and test data are presented for the atomic time and frequency reference system for manned space flight use. Circuit block modules are described, and circuit diagrams are given. The modules include the optical package, master crystal oscillator and phase locked oscillator multipliers, RF amplifier, microwave multiplier-mixer, servo system, heater controllers, magnetic bias, power supply, and clock and time-code generators. It is concluded that electrical and mechanical test data indicate the feasibility of rubidium frequency standards for space application. It is also considered that substantial improvements beyond specifications were achieved, particularly in size, weight, and power consumption. N.E.N.

N70-20594*# Utah Univ., Salt Lake City. Dept. of Electrical Engineering.
GENERATION OF UNCERTAINTY BOUNDARY FOR ARCASONDE 1A TEMPERATURE SENSOR SYSTEM Progress Report
Shigetaka Kikkawa and Forrest L. Staffanson Aug. 1969 113 p refs
(Grant NGL-45-003-025)
(NASA-CR-66896; UTEC-MR-69-109) Avail: CFSTI CSCL 14B

A method of computing error bars for the temperature profile from a thermistor-type meteorological rocketsonde is presented. The resultant uncertainty is derived from estimated uncertainties in the parameter values assumed in the mathematical data correction relations. The uncertainty boundary is defined and the method of combining uncertainties is discussed. A computer program in FORTRAN V is developed which computes corrections and uncertainties for real flight data. Simulated flight data is generated and used for illustration. Nominal values and uncertainty estimates for the parameters are those associated with the ARCASONDE 1A film mounted thermistor sensor system. Quantitative results reveal the relative sensitivity of the corrected temperature to the various parameters. Sensor improvement with the use of a radiation shield is illustrated in terms of reduced uncertainty boundary. Author

N70-20626*# Tempil Corp., New York.
PHASE CHANGE INDICATORS FOR SUBAMBIENT TEMPERATURES
D. R. Kasanof and E. Kimmel Washington NASA Mar. 1970 15 p ref
(Contract NAS1-5667)
(NASA-CR-1576) Avail: CFSTI CSCL 14B

Forty candidate organic compounds were evaluated as possible fusible temperature indicators for use in the range −50 F to −150 F. Of these, thirty with melting points ranging from −37 F to −162 F were found to be useful as temperature indicators. Nine candidates were rejected because they did not yield opaque,

crystalline coatings by any of the application procedures attempted. One candidate material was rejected because it proved to be unstable. Phase studies of several binary systems were also carried out. A number of application procedures were evaluated. An aerosol-spray procedure was adopted because it consistently yielded opaque coatings, was relatively simple to employ and could probably be adapted for use in the Langley Field test apparatus. The indicators were found to signal properly at a reduced pressure of 2mm mercury, as well as at sea-level barometric pressure.
Author

N70-20644 National Lending Library for Science and Technology, Boston Spa (England).
STUDIES ON THE DESIGN OF THE 1000 METRE TELESCOPE
O. Hachenberg 22 Oct. 1969 36 p ref Transl. into ENGLISH from Beitr. Radioastronomie (Bonn), v. 1, no. 2, Dec. 1968 p 31–61
(NLL-RISLEY-Trans-1749-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .6 NLL photocopy coupons

Investigations into possible designs for a large radio telescope are described. The advantages and disadvantages of the multi-element design with four medium sized parabolic antennas and of the fully moveable telescope with associated aperture surface constructed as a large parabolic antenna are compared, and the latter was chosen. The proportions of the parabola, noise reduction in the antenna and antenna connections, and errors in the reflector surface from component production and erection are discussed. Moveable reflector constructions in use and ways of reducing elastic deformations are reviewed. Further investigations were made on dish models with four or six, and with eight points of support, and on binder construction. A plate design with axial anchorage using binder construction and similar to the dish was chosen. The influences of wind, solar radiation, and atmospheric temperature are considered, and systems to give fine resolution control are outlined. The technical data for the final design and initial construction work are reported.
N.E.N.

N70-20648*# National Bureau of Standards, Washington, D.C.
PRELIMINARY RESULTS OF NOBLE METAL THERMOCOUPLE RESEARCH PROGRAM, 1000 - 2000 C
J. Stern, S. Edelman, P. Freeze, and D. Thomas Jan. 1970 28 p refs
(NASA Order C-19068-B; NBS Proj. 4253439)
(NASA-CR-72646) Avail: CFSTI CSCL 14B

The effect of catalysis on platinum disclosed significant effects over the temperature range of 1000 to 1500 C at very low velocities. A facility was designed to extend these studies to higher flow rates. Development, design, construction, and test of a facility were evaluated for thermoelectric stability studies of the thermocouple combination. A facility for generating controlled temperature gradients was developed so that their effects on thermocouple calibration may be determined.
Author

N70-20649*# North American Rockwell Corp., Los Angeles, Calif.
RUGGEDIZED GAMMA RADIATION DETECTOR Final Report
T. E. Carrell 23 Sep. 1969 74 p refs
(Contract NAS8-20840)
(NASA-CR-102509; NA-69-609) Avail: CFSTI CSCL 18D

Presented in this report is a description of the design, fabrication, and testing effort conducted to provide a prototype gamma radiation detector capable of operating in the severe environment that will be encountered in the vicinity of a nuclear powered rocket engine. The technical discussion centers on the theory of detector operation, specific details of fabrication and the results of performance qualification testing. The ruggedized gamma radiation detector is designed to measure gamma radiation intensities in the range of 100,000 to 10 to the 7th power roentgens/hour in a space, ambient and liquid helium environment. It is a self powered device that is capable of operating in a high neutron field, and under extreme conditions of shock and vibration. The three prototype detector developed have successfully demonstrated compliance with all of the technical requirements.
Author

N70-20654*# Harvard Coll. Observatory, Cambridge, Mass.
OSO-G1 EXPERIMENT HANDBOOK
R. Dower, S. Diamond, and N. Hazen May 1969 84 p
(Contract NAS5-9274)
(NASA-CR-108915; TR-10) Avail: CFSTI CSCL 17H

The scientific objectives of the orbiting solar observatory instrument, the instrument's components, instrument spacecraft interface parameters, and appropirate handling, storage, inspection, and testing procedures are summarized. Sufficient technical background material is given to make it useful to persons of varied technical knowledge. It is also intended to be used as a major source of information for persons actually handling the instrument.
Author

N70-20657*# Avco Corp., Wilmington, Mass. Systems Div.
ENTHALPY-MASS FLUX-IMPACT PRESSURE-PROBE SYSTEM DESIGN FOR NASA ARMSEF FACILITY, 28 OCTOBER 1968 - 27 FEBRUARY 1970
T. J. O'Connor Feb. 1970 111 p refs
(Contract NAS9-7984)
(NASA-CR-108295; AVSD-0094-70-CR) Avail: CFSTI CSCL 14B

The design of a probe system capable of measuring enthalpy, impact pressure, and local mass flux within the hypersonic flow field is described. The design of the enthalpy probe, the mass flow measuring system, and flow meter calibration system are included. Data obtained in evaluation of the probe system are also discussed.
Author

N70-20660# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
TROCHOIDAL E × B ANALYSER FOR HOT ELECTRON PLASMA
S. Kawasaki [1969] 3 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug.-6 Sep. 1969
(CEA-CONF-1391; CONF-690803-24) Avail: CFSTI

An E × B electron analyzer used by Perkins and Barr, which is placed in a homogeneous axial magnetic field, is a convenient spectrometer for the measurements of hot electrons flowing out from an open-ended system. One variant of their analyzer is proposed here which is theoretically valid for electrons up to relativistic energies without ambiguity accompanied with the Larmor oscillation. These characteristics are obtained by the application of the focusing property of charged particles in E × B fields. An analyzer of this type was designed so as to measure the distribution functions of hot electrons escaping from a mirror-confined plasma. Its application to the Bille-en-Tete system is specified.

N70-20665*# Boeing Co., Seattle, Wash.
A STUDY OF PROTON INDUCED EFFECTS ON REFLECTIVE SURFACES OF SPACE MIRRORS
Roger B. Gillette and Bruce A. Kenyon Washington NASA Feb. 170 94 p refs
(Contract NAS 1-7627)
(NASA-CR-1532) Avail: CFSTI CSCL 20F

The results of a study on the effects of low energy protons on reflective surfaces for space optical systems are presented. The primary objective was to determine the effects on telescope mirror reflective surfaces of the proton radiation environment at synchronous earth orbit. Secondary objectives were to obtain information on surface finish characteristics and reflectance characteristics of three mirror substrates. Mirror test specimens evaluated included polished substrates of fused silica, Cer-Vit, and Kanigen-nickel-plated beryllium; coated with aluminum and

overcoated with MgF2. Also included were specimens of polished fused silica coated with aluminum and LiF. The experimental program studied the dependence of specular reflectance and scattering properties on: (1) proton integrated flux; (2) proton flux; (3) post-irradiation exposure to air; and (4) coating and substrate type. Author

N70-20680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROLL ALIGNMENT DETECTOR Patent Application
Clarence Cantor inventor (to NASA), and Irving B. Lowen inventor (to NASA) Filed 31 Oct. 1969 28 p
(NASA-Case-GSC-10514-1; US-Patent-Appl-SN-873045)
Avail: CFSTI CSCL 14B

A method and apparatus for precisely measuring roll misalignment of a test body with respect to a reference body is presented. Two light sources are provided on the test body. The light sources are focused upon a rotating disc. The light images are intercepted by an aperture on the rotating disc to illuminate detectors behind the disc. Measurement of the angular displacements at the times of detector illumination gives a precise indication of roll misalignment of the body under test. Accurate roll misalignment is measured even in the event that the body under test is displaced laterally in addition to angularly about the light of sight. The unique geometry that enables this apparatus to be insensitive to lateral displacements is presented. NASA

N70-20710*# National Aeronautics and Space Administration. Electroncis Research Center, Cambridge, Mass.
CLEAR TURBULENCE DETECTOR Patent Appl.
George G. Haroules, Wilfred E. Brown, III, Harold I. Ewen, Arthur Edward Lilley, and Ralph D. Kodis, inventors (to NASA) Filed 19 Nov. 1969 31 p
(NASA-Case-ERC-10081; US-Patent-Appl-SN-877990) Avail: CFSTI CSCL 14B

An apparatus is described for warning the pilot of an aircraft of a region of clear air turbulence. A multichannel radiometric sensor mounted on the aircraft detects both the ambient temperature of the air and any temperature anomaly that is present along the forward flight path. Where temperature anomalies are associated with the presence of a clear air turbulence region, the device senses these anomalies through the application of a unique radiometric technique detecting the difference in temperatures between a minimum of two channels. The distance from the aircraft to the anomalous temperature region is directly determined from the output indication of the radiometric sensor channels. The distance between the clear air turbulence region and the aircraft is determined by utilization of at least two observing frequencies which have known absorption coefficients of different values. NASA

N70-20711*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IMAGE COPIER Patent Application
Harold S. Miller, Stanley H. Dinsmore, and Fred C. Billingsley, inventors (to NASA) Filed 28 Oct. 1969 34 p
(Contract NAS7-100)
(NASA-Case-NPO-10186-2; US-Patent-Appl-SN-871977) Avail: CFSTI CSCL 14E

An image copier system is described which is particularly suited for use in film editing and composite reproduction, and is characterized by a plurality of interrelated image frame projectors adapted to be selectively actuated for projecting a plurality of images along angularly related paths and optic means for selectively combining the projected images into an assembled composite. A feature of the system is the provision of a visual display and a selectively operable control circuit for independently controlling the projectors, whereby film editing and composite reproduction are enhanced. NASA

N70-20712*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADIOMETRIC TEMPERATURE REFERENCE Patent Application
Leo G. Monford, Jr., inventor (to NASA) Filed 26 Nov. 1969 13 p
(NASA-Case-MSC-13276-1; US-Patent-Appl-SN-880272) Avail: CFSTI CSCL 14B

A system or component having an electrical characteristic which varies with changes in its own temperature is employed as part of a feedback loop in an operational amplifier circuit. Power applied to the device raises its temperature which in turn changes the value of its electrical characteristic. The output of the operational amplifier circuit forms the input to a second operational amplifier where the polarity of the signal is inverted and fed back to the input of the first operational amplifier circuit in a positive feedback loop. The associated circuitry automatically alters the power supplied to the device causing it to heat or cool until an equilibrium condition is reached which corresponds to a fixed temperature and fixed energy radiation of the device. NASA

N70-20729*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIDE RANGE DYNAMIC PRESSURE Patent Application
John Dimeff and James W. Lane, inventors (to NASA) Filed 4 Dec. 1969 19 p
(NASA-Case-ARC-10263-1; US-Patent-Appl-SN-882122) Avail: CFSTI CSCL 14B

A dynamic sensor is described which has a diaphragm placed between two metal plates, one of which drives the diaphragm electrostatically and the other senses the movement of the diaphragm by changes in capacity between the sensing plate and the diaphragm. By vibrating the diaphragm at its resonant frequency and at a constant amplitude, the driving force necessary can be measured and correlated with the density or pressure of the gas surrounding the diaphragm. By substituting perforated plates for solid ones, and spacing them from the walls of the cavity of the transducer, the volume of gas between the plates and the diaphragm is much less than the total volume of gas in the transducer and the effect of increased damping with increased pressure is much lessened. The device allows accurate measurements of gas pressures as high as 10,000 torr, is very insensitive to gas composition, and is also adapted to be made out of materials which are heat sterilizable. NASA

N70-20732*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
OPTICAL SYSTEMS HAVING SPATIALLY INVARIANT OUTPUTS Patent Application
Thomas M. Hard, inventor (to NASA) Filed 22 Oct. 1969 28 p
(NASA-Case-ERC-10248; US-Patent-Appl-SN-868445) Avail: CFSTI CSCL 17H

Optical systems are described that have output beams that are spatially invariant to the angle of incidence upon a certain rotatable surface forming a part of the systems, and can be used to select the wavelength of the output of an optical source, such as a laser cavity, or to aid in measuring the reflectance of a material in reflectance spectroscopy. The optical systems comprise various combinations of plane mirrors and plane diffraction gratings, and, in some embodiments, spherical mirrors. Moveable elements are attached to arms extending from the shaft of a suitable movement mechanism, such as a micrometer. By rotating the shaft to a particular incidence angle, the frequency of the output of a laser cavity can be selected. Alternately, the reflectance of a material can be observed for a particular angle of incidence when the shaft is rotated to that angle. NASA

N70-20741*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTICAL PROBING OF SUPERSONIC FLOWS WITH STATISTICAL CORRELATION Patent Appl.

Buford H. Funk, Jr., inventor (to NASA) Filed 4 Nov. 1969 34 p
(NASA-Case-MFS-20642; US-Patent-Appl-SN-873793) Avail: CFSTI CSCL 14B

A method and apparatus are described for optical sensing of supersonic flows by correlating deflections in laser beams through the flow. Deflections in the laser beams are converted into meaningful electrical signals by use of a knife-edge before a photodetector, and the knife-edge is rotatable whereby both the translational and rotational motion of turbulent flow structures may be determined. NASA

N70-20748*# Harvard Coll. Observatory, Cambridge, Mass.
HIGH VOLTAGE BREAKDOWN IN AN OSO-4 POINTED EXPERIMENT
V. L. Hazen, M. C. E. Huber, and E. M. Reeves Mar. 1969 37 p refs Presented at the Proc. of the Voltage Breakdown in Electron. Equipment at Low Air Pressures Workshop, Pasadena, Calif., 5-7 Mar. 1969 Submitted for publication
(Contracts NAS5-9274; NAS4-184; Proj Solar Satellite)
(NASA-CR-109085; TR-11) Avail: CFSTI CSCL 14B

A high voltage failure occurred in the solar spectrometer-spectroheliometer experiment aboard the OSO-4 spacecraft five weeks after launch. This failure is analyzed and traced to a sequential process comprising two modes which took place within the high voltage power supply. The primary failure was within the transformer. The test history of this and previous instruments is discussed, including pertinent work on subassemblies and modules. This testing included extensive thermal-vacuum work and corona and plasma exposure. Preventive measures that are being taken are discussed, including pertinent recommendations in manufacturing technique, qualification and acceptance tests, and an overload switch that automatically turns off the high voltage power supply. Author

N70-20761*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
AN EXPERIMENTAL FOURIER-TRANSFORM ASYMMETRICAL INTERFEROMETER FOR ATMOSPHERIC RADIATION MEASUREMENTS
L. W. Chaney Dec. 1969 67 p refs
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-108967; Rept-05863-18-T) Avail: CFSTI CSCL 14B

An experimental Fourier transform spectrometer was modified to operate in an asymmetrical mode for the purpose of increasing the resolution. The computational problems associated with the asymmetrical mode are described. The instrument was flown on a high altitude balloon flight on November 20, 1968 and some of the data obtained during the flight is presented. Author

N70-20822*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A BALANCE FOR MEASURING THE PLANAR COMPONENTS OF SMALL FORCES
M. A. Messier 10 Feb. 1970 86 p refs
(Grant NGL-39-009-015)
(NASA-CR-109094; SR-348) Avail: CFSTI CSCL 14B

An instrument has been developed which is capable of measuring small forces along the two axes of a plane. The instrument was designed specifically for use in a molecular beam, but can be used for a variety of measurements ranging from magnetic fields to accelerations. A gravitational calibration experiment was performed and it was shown that millidyne forces were easily measured. It appears feasible to attempt detection of forces at the order of 0.00001 dyne with this type of apparatus. Author

N70-20828# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
MEASURING 14 PROPERTIES WITH THE MULTI-PURPOSE INSTRUMENT AND A TEMPERATURE FREE METHOD OF MEASURING THERMAL TRANSPORT PROPERTIES Final Scientific Report
Wolfgang Leidenfrost Aug. 1969 67 p refs
(Contract AF 49(638)-1574)
(AD-697821; WLRAF-6; AFOSR-69-2155TR) Avail: CFSTI CSCL 14/2

A multi-purpose instrument originally designed to determine seven properties was extended in its capabilities to measure additional properties. The paper describes briefly the instrument and the operational procedures and brings the results of measurements of some of the properties, namely: four properties of the instrument or its wall material, thermal conductivity of He, N2 and C4F8 (in vapor and liquid state), p-v-T data of N2, dielectric constant of N2, He, A, and C4F8- vapor and liquid, vapor pressure of methanol, thermal expansion coefficient of Benzene, index of refraction and polariability of N2. A new unsteady method was introduced for the determination of heat transfer and thermal transport properties without measuring temperature and its technique was demonstrated by heat transport observations in He, A, N2 and vacuum. Whenever possible comparison with reference data were made. The agreement was in practically all cases excellent. Author (TAB)

N70-20846*# Rensselaer Polytechnic Inst., Troy, N.Y.
THE DESIGN STUDY OF A LIGHTWEIGHT ROTOR HUB FOR A MARS-LANDING AUTOGYRO
Wilson Parker Rayfield Sep. 1969 51 p refs
(Grant NGL-33-018-091)
(NASA-CR-108971; RPI-TR-MD-7) Avail: CFSTI CSCL 17G

The use of an inflatable-blade autogyro device has been proposed to soft-land a 150 pound (earth-weight) instrument package on the planet Mars. To help determine the feasibility of this plan, a compact, extremely light-weight rotor-hub assembly was designed. Capable of monitoring the average coning angle of the three blades, the hub controls the rotor speed and thrust by adjusting the collective and cyclic blade pitches. Using a gas-lubricated main bearing, several solid-lubricant ballbearings, plastic blade hinges and linkages, the weight of the entire assembly is estimated between 15 and 20 pounds. Author

N70-20893*# Stanford Research Inst., Menlo Park, Calif.
CONSTRUCTION OF ATS CLOUD CONSOLE Final Report
William E. Evans and Sidney M. Serebreny Dec. 1969 58 p
(Contract NAS5-11652; SRI Proj. 7711)
(NASA-CR-109082) Avail: CFSTI CSCL 14B

The design approach and final configuration of an experimental device to permit rapid analysis of cloud image sequences generated by synchronous meteorological satellites is described. A self-contained console includes a film input station, a television camera, 1000 frames of video disc memory, video mixing controls, and a television display. Electronic cursors permit digital readout of x and y displacements of identifiable cloud elements relative to a reference grid. Numerous display options, including time-lapse, variable magnification, and frame-to-frame differencing are provided to help a meteorologist/operator identify and track specific cloud elements. Other types of graphic material, e.g. charts, contours, and grids, can be entered and merged with the cloud images for comparative study. The equipment design is expandable to include data input from digital tapes and immediate feedback of processed results via an associated on-line digital computer. Examples of meteorological satellite imagery processed through the console are included. Author

N70-20944# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL WORLD: SELECTED ARTICLES, VOLUME 17, NO. 5, 1964
Chih-Ch'eng Fang et al 18 Jun. 1969 18 p refs Transl. into ENGLISH from Tien Shih Chieh, (Mainland), v. 17, no. 5, 1964 p 185-187
(AD-692639; FTD-HT-23-1126-68) Avail: CFSTI CSCL 14/2

Contents: Electrical measurement of mechanical vibrations; Centrifugal pump automatic device in chemical plant. TAB

N70-20967# Akademiya Nauk URSR, Kiev.
FACTORS WHICH DETERMINE SIGNAL AMPLITUDE IN A HELIUM MAGNETOMETER
L. I. Grabar, V. N. Mikhaylovskiy, and V. D. Sokolov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 114–124 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

The conditions are discussed for obtaining maximum signal amplitude in helium magnetometers which use optical pumping of metastable helium atoms. These include signal amplitude as a function of helium pressure in the absorption chamber, intensity of the electric field causing discharge, the path length of pumping light through the chamber, light intensity, and the cross section area of the light beam. Experimental findings show that variations in absorption chamber length result in different optimum values of helium pressure and excitational electrical field intensity. Increases in chamber length also lead to an increased signal amplitude. To obtain maximum output chamber signal amplitude, it is thus necessary to establish optimum values of helium pressure and electromagnetic field intensity. B.E.S.

N70-20968# Akademiya Nauk URSR, Kiev.
HELIUM LAMPS AND ABSORPTION CHAMBERS FOR QUANTUM MAGNETOMETERS
G. M. Golubets, L. I. Grabar, L. F. Lutsivshumskiy, V. N. Mikhaylovskiy, and V. V. Turkevich *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 125–130 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

A test model helium magnetometer which operates under a total vacuum of 4×10 to the -7th power torr is described. Parametric levels that were applied and operational characteristic curves are presented. The stability of operation was closely monitored over long periods of time. The experiment shows that the pump lamp and the chamber functioned more than 2000 hours with insignificant changes in signal resonance. B.E.S.

N70-21007# Army Foreign Science and Technology Center, Washington, D.C.
INFORMATIONAL MATERIALS ON HYDROMETEOROLOGICAL INSTRUMENTS AND OBSERVATION METHODS
A. A. Eliseev et al 5 Nov. 1969 13 p Transl. into ENGLISH from Nauchn.-Issled. Inst. Gidrometeorol. Priborostr. (Leningrad), no. 33, 1967 p 40-42
(AD-697520; FSTC-HT-23-634-69) Avail: CFSTI CSCL 4/2

Improvements in the operation and configuration of certain technical equipment used for meteorological purposes is summarized. These improvements include revised adjustments for ice measuring machines, a modification to increase the range of measurement of radiosonde signals, a recommended change in theodolite ventilating fans and a revised buzzer circuit for the PO-15 undulator. Author (TAB)

N70-21008# Army Foreign Science and Technology Center, Washington, D.C.
A CALCULATED ANALYSIS OF CERTAIN PARAMETERS OF A SLANT TRANSPARENCY METER
V. A. Markelov 6 Nov. 1969 13 p ref Transl. into ENGLISH from Nauchn.-Issled. Inst. Gidrometeorol. Priborostr. (Leningrad), no. 18, 1968 p 81-86
(AD-698078; FSTC-HT-23-707-69) Avail: CFSTI CSCL 4/2

A design-analytical analysis covers the selection of two parameters of a slant transparency meter: the secondary light source height and the angles between the optical axes of a quantum optical generator and the receiver. The analysis reveals that with an increased secondary light source height and a decreased angle between the optical axes, slant illumination is decreased. Author (TAB)

N70-21087# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PUBLICATIONS OF THE W. STRUVE ASTROPHYSICAL OBSERVATORY AT TARTU
M. Liigant Jan. 1969 104 p refs Transl. into ENGLISH from Astrofiz. Observ. Tartu, Publikatsii (USSR), v. 35, no. 4, 1966 129 p
(AD-687011; FTD-HT-23-588-68) Avail: CFSTI CSCL 17/8

Contents: On the theory of photographic cameras for observation of artificial earth satellites; Equations of apparent motion of artificial earth satellites; Theory of satellite tracking cameras; Determination of the parameters of a small circle approximating the apparent orbit of an artificial earth satellites; and Precision of earth-satellite tracking cameras. TAB

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-19709# National Engineering Lab., Glasgow (Scotland). High Temperature Materials and Metallurgy Div.
SURFACE STUDIES IN THE INVESTIGATION OF FAILURE MECHANISMS
D. Scott Sep. 1968 14 p refs
(NEL-384) Copyright. Avail: CFSTI

Changes in topography, chemical nature, structure and physical properties of surfaces subjected to sliding, rolling, abrasion, corrosion, deformation and repeated stressing have been studied. Optical and electron microscopy and electron probe microanalysis have been used to obtain information for the elucidation of failure mechanisms and their controlling factors. The paper reviews work which has been carried out in recent years, mainly from the technological viewpoint. Author

N70-19750# National Engineering Lab., Glasgow (Scotland). Formation and Fabrication Div.
THE PERFORMANCE OF COLD EXTRUDED CANS AND TUBES SUBJECTED TO INTERNAL PRESSURE
A. K. Cruden Jun. 1969 15 p refs
(NEL-422) Copyright. Avail: CFSTI

The bursting strength of cans produced by the backward extrusion of steel En2A and subjected to internal pressure was compared with that of cans of the same dimensions produced by machining from the original material En2A, from steel En12 and subsequently hardened, and from steel En16 also subsequently hardened. Tubes which were cold extruded at four different extrusion ratios were similarly tested, and their bursting strength compared with that of commercial tubing supplied in three different classes. The bursting strength of the cold extruded cans was greater than that of cans machined from steel En2A and of cans machined from steel En12 subsequently hardened. The strength of the cold extruded tubes increased with reductions of up to 59 per cent and was comparable with the strength of commercial quality cold drawn tubing of the same dimensions. Author

N70-19820# National Engineering Lab., Glasgow (Scotland). Fluid Mechanics Div.
A CORRELATION OF TIP CLEARANCE EFFICIENCY MEASUREMENTS ON MIXED FLOW AND AXIAL FLOW TURBOMACHINES
J. E. Hesselgreaves Jul. 1969 11 p refs
(NEL-423) Copyright. Avail: CFSTI

Correlation is made of the published results of efficiency versus tip clearance measurements of a number of single-stage axial-flow pumps and fans with measurements made on mixed-flow machines. An increase of tip clearance is shown to have two distinct effects: to reduce the work output of the machine owing to the change in loading distribution on the blade, and to reduce the efficiency owing to the loss in kinetic energy of the flow through the clearance gap. The correlation is based on a modification by Vavra of a theoretical model proposed by Rains, and provides a rapid method of estimating efficiency losses due to clearance changes in terms of machine design parameters. The effect of the casing boundary layer is discussed and in many cases is shown to be of secondary importance in the assessment of losses. Author

N70-19865*# Louisiana State Univ., Baton Rouge.
UTILIZATION OF LIQUID NITROGEN FOR REFRIGERATED STORAGE OF SHRIMP
[1969] 16 p
(Grant NGL-19-001-068)
(NASA-CR-102462) Avail: CFSTI CSCL 13A

A refrigeration system utilizing liquid nitrogen as the refrigerant was designed, fabricated, and then installed aboard a boat which was outfitted for shrimping in Gulf Coast areas. Shrimp were than caught, processed and stored in an on-board refrigeration box which was designed as a receptacle for the freshly caught shrimp. Liquid nitrogen was introduced into the box in controlled amounts which were sufficient to maintain the temperature of the shrimp between 28–32 F. Temperatures of the interior of the box and of the shrimp were monitored and recorded. Shrimp which were stored in ice for the same period of time served as the control. The data which were collected during the test period demonstrated the superiority of liquid nitrogen storage over conventional ice storage. With the liquid nitrogen system, temperature of the shrimp was maintained at a uniform level, and microbial decomposition of the shrimp was retarded when compared with ice storage. Author

N70-20055# Stevens Inst. of Tech., Hoboken, N.J. Cryogenics Center.
MINIATURE CRYOGENIC REFRIGERATORS Technical Report
John G. Daunt and William S. Goree Aug. 1969 48 p refs
Prepared in cooperation with Stanford Res. Inst.
(Contracts Nonr-263(70); N00014-67-C-0393)
(AD-697972; TR-1(ONR)) Avail: CFSTI CSCL 13/1

The report gives data in tabular and graphical form on miniature cryogenic refrigerators available commercially in the USA and Europe. It also gives data on prototype miniature refrigerators under development in commercial laboratories. A graphical comparison is given of the refrigerators listed by presenting efficiencies, weight/refrigeration ratios and volume/refrigeration ratios. Brief discussions are given also of passive cooling techniques and of possible developments envisioned for the future. Author (TAB)

N70-20089# Auburn Univ., Ala. Industrial Engineering Dept.
PROBIM 5 INSTRUCTOR MANUAL
Joe H. Mize, Bruce E. Herring, Nyung S. Chun, Cliff Cook, and L. Ord Nov. 1969 317 p
(Contract DAAH01-68-C-0296)
(AD-698041; AU-T-5) Avail: CFSTI CSCL 5/1

A production system simulator has been developed which is capable of simulating a wide variety of realistic manufacturing environments. The simulator is used as an aid in teaching the concepts of designing production control systems and as a research vehicle for investigating various aspects of control theory for production systems. The report contains the instructor manual which explains to the instructor how the simulator works, how it can be used to bring a dynamic experience into a production control system design course, how to generate problems, and how to administer its use. Included are four complete problems, a method for checking the local installation of the simulator and a complete listing of all source programs. Author (TAB)

N70-20216# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE, PHASE 2 Progress Report, May – Sep. 1969
Robert J. Eiber, Willard A. Maxey, Arthur R. Duffy, and Thomas J. Atterbury Oct. 1969 7 p
(Contract W-7405-eng-92)
(BMI-1873) Avail: CFSTI

Ductile pipe rupture studies were continued. The initial phase experimental data provided a basis for assessing the size of defects required to produce failure in piping systems of either pressurized-water or boiling-water reactors. The current studies were concerned with determining the effects of pressure, mechanical stress, tube geometry, and flaw orientation on the initiation and arrest of crack propagation in stainless and carbon steel pipe, and with determining the range of area-opening-versus-time rates generated in the pipe failure experiments. NSA

N70-20245# Army Foreign Science and Technology Center, Washington, D.C.
DEPENDENCE OF STRUCTURE AND PROPERTIES OF TITANIUM ALLOY FORGINGS ON TEMPERATURE AND DEGREE OF DEFORMATION
N. G. Yevlanov et al 27 Oct. 1969 28 p refs Transl. into ENGLISH from Aviatsionnyi Tekhnologicheskii Inst. (Moscow), no. 69, 1968 p 165-170
(AD-698077; FSTC-HT-23-111-69) Avail: CFSTI CSCL 13/8

The first section of this collection of articles deals with theoretical investigations of rolling, drawing and hardening processes of metal during cold plastic deformation. The second section is devoted to production technology involving granular materials based on aluminum and copper, while the last section deals with the production of high-durability semi-finished products manufactured from heat-resistant alloys. Author (TAB)

N70-20368# Owens-Corning Fiberglas Corp., Granville, Ohio. Technical Center.
GLASS FIBER REINFORCED PLASTIC PRESSURELESS TIRE Final Report
James C. Hood Oct. 1969 70 p refs
(Contract DAAE07-67-C-4319)
(AD-698036; TACOM-TR-10696) Avail: CFSTI CSCL 13/6

The program sought to provide adequate data on which to base a judgment of the probability of success in producing a satisfactory glass fiber reinforced plastic pressureless tire by the filament winding method. The tire sought represents an entirely new and unique concept in automotive tires, and would be impossible to deflate. A process was developed to produce a preliminary model of a 7.00 x 16 tire. Several tire configurations were wound and tested statically, and dynamically on an indoor wheel. The feasibility of a glass fiber reinforced plastic pressureless tire was demonstrated. Author (TAB)

N70-20472*# Applied Magnetics Corp., Goleta, Calif.
FRICTIONAL WEAR OBSERVATIONS ON CERAMIC IN CONTACT WITH A Ni-Co RECORDING DISC Final Report
[1969] 20 p
(Contract NAS5-10127)
(NASA-CR-108918) Avail: CFSTI CSCL 13H

The wear resulting when a ceramic recording head is run in contact with a metallic plated recording disk was studied. In addition to design and fabrication of the equipment, two separate test sequences were run to demonstrate the actual wear results. During the tests all significant physical and electrical test data were recorded, including catagorizing samples, photo monitoring of wear and wear products, and recording head signal levels. The

nature of the tests performed allowed a direct comparison of two different types of disk surfaces under the same test conditions: an electroless plated magnetic coating versus an electroplated coating directly in contact by the recording head. The results of the test indicate that for the particular conditions outlined, presently available magnetic coatings and in-contact heads can be made to operate satisfactorily for at least 100,000 passes of the disk over the recording head. Author

N70-20502# Army Foreign Science and Technology Center, Washington, D.C.

METHODS OF ELECTRICAL MODELLING OF THE HYDRAULIC SECTIONS OF AIR COOLING SYSTEMS OF GAS TURBINES WITH THE AID OF SERIES INTEGRATORS

L. A. Kozdoba et al. 6 Nov. 1969 23 p refs Transl. into ENGLISH from Mashinostr (Kiev), no. 4, 1967 p 39–50 (AD-698162; FSTC-HT-23-705-69) Avail: CFSTI CSCL 21/5

An analytical method is proposed for the electrical modelling of the hydraulic sections of gas turbine air cooling systems in order to permit increased efficiency through the use of higher temperatures in the working environment of turbine assemblies. The computations involved in designing a more efficient cooling system are simplified by the use of electrical models with linear impedances. Author (TAB)

N70-20528# General Electric Co., Philadelphia, Pa.

UNIT SEPARATION PROCESSES IN SPACE

L. R. McCreight and R. N. Griffin *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 216–237 refs (See N70-20517 08-20)

Avail: CFSTI

Some unit separation processes used for purifying chemicals and biologicals (vaccines) are clearly affected by the earth's gravity and therefore might be improved by operation in space. Centrifugation and electrophoresis are the prime examples of such processes. Meanwhile other processes such as freeze drying and ultraviolet sterilization are desirable adjuncts in a spectrum of processes that could permit the complete preparation of vaccine or other materials in space. The freeze drying operation would take advantage of the low temperatures and vacuum of space. Author

N70-20531*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

METALS MELTING AND EXOTHERMAL HEATING

Robert V. Hoppes *In its* Space Process. and Manufacturing 5 Feb. 1970 p 262–270 (See N70-20517 08-30)

Avail: CFSTI CSCL 13H

Two of the experimental tasks approved as part of M 512 space experiment are metals melting (electron beam welding) and exothermal heating (tube brazing). The two tasks have similar objectives: 1) to learn about the behavior of molten metal in a reduced gravity environment, and 2) to demonstrate two heat sources for melting materials in space, 3) to establish a method of joining and repairing. Four materials will be used in the first task—SS, Ti, Al, and TDNi. A beam of constant power density will impinge on a revolving plate with a melt circle diameter of seven inches. In the second task, sixteen SS tubes will be joined by brazing, using exotherm heat sources. Author

N70-20532*# Little (Arthur D.), Inc., Cambridge, Mass.

SPHERICAL FORMING AND COMPOSITE CASTING IN ZERO g

A. E. Wechsler, J. Berkowitz-Mattuck, P. C. Johnson, and L. B. Griffiths *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 271–296 (See N70-20517 08-30)

(Contract NAS8-21402)

Avail: CFSTI CSCL 13H

The formation of spheres in the zero-g environment of an orbiting spacecraft has the potential for enhancing the surface finish, hardness, sphericity and microstructural properties. Casting of composites has the potential for better fiber alignment and a more homogeneous structure which could lead to improved strength or unique physical properties. This paper describes a program conducted to assist the Manufacturing Engineering Laboratory of NASA/MSFC in the identification and selection of materials and methods for the spherical forming and composite casting experiments of the AAP Workshop. Author

N70-20538*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NEW DEVELOPMENT IN SPACE MANUFACTURING

Hans F. Wuenscher *In its* Space Process. and Manufacturing 5 Feb. 1970 p 337-345 (See N70-20517 08-30)

Avail: CFSTI CSCL 13H

The progress in space manufacturing development is reviewed. The possibilities of processes in zero and low "g" environment have been considered in industry, at universities and research institutes, and government agencies. Areas of interest stimulated conceptual studies and evaluation of economical aspects. In-depth assessment of feasibility is underway. The tabulation of unique space processes is brought up-to-date. New processes which have emerged are discussed. The present coverage by research and technology development toward space experiments is assessed, and recommendations for future development areas are given. Author

N70-20536# General Dynamics Corp., San Diego, Calif.

COMPOSITE CASTING SUPERIOR STRUCTURAL MATERIALS THROUGH THE COMBINED APPLICATION OF UNIQUE ZERO g EFFECTS

W. H. Steurer *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 351-374 refs (See N70-20517 08-30)

Avail: CFSTI

The basic process, which employs primarily the zero-g phenomenon of mixture stability, comprises two methods: mold casting and free casting. Composite casting is of particular interest for the demonstration of space manufacturing capabilities in early experiments. An experiment program is proposed, specifying individual experiment conditions (materials, batch size, mold shape), equipment requirements (design, vehicle arrangement, support requirements), operations (controls, astronaut assistance) and expected results. The proposed experiment schedule, providing for a gradual increase of capabilities and an effective correlation with other experiments, is based on presently planned vehicle availability (workshop, space station) and on anticipated experiment hardware leadtimes. Author

N70-20548*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Md.

THEORETICAL CONSIDERATIONS FOR LIQUID PHASE SINTERING AND SOLIDIFICATION IN THE SPACE ENVIRONMENT

Richard Fabiniak, Thaddeus Fabiniak, Eugene Mc Kannan, and Robert Abbott *In its* Space Process. and Manufacturing 5 Feb. 1970 p 448-468 refs (See N70-20517 08-30)

Avail: CFSTI CSCL 13H

Many types of materials processing experiments planned for operation in the space environment involve crystal growth, metals joining, solidification or sintering. Complete characterization of the liquid-solid interface is essential for analysis of these experiments. The necessary interface condition of wetting is effected by both zero gravity and the composition of the environment. Wetting is achieved by decreasing the solid-liquid interface energy through preferential adsorption of one of the constituents in the liquid on the solid surface and/or by diffusion fluxes. Adsorption of the environmental gases on the solid surface prior to exposure to the liquid phase will decrease the solid-vapor interfacial energy and inhibit the wetting process. Sintering and joining processes involve two steps: First a solid-solid phase and then a liquid-solid phase. Author

N70-20574# Army Foreign Science and Technology Center, Washington, D.C.

HYDRAULIC AMPLIFIER

A. A. Lyubimov et al 19 Nov. 1969 7 p Transl. into ENGLISH from Russian Patent no. 217764 (13 Feb. 1967)
(AD-698186; FSTC-HT-23-199-70) Avail: CFSTI CSCL 13/7

The proposed hydraulic amplifier differs from those already known for increasing accuracy, simplifying the design and ensuring the independence of the output parameter from a change in pressure and drainage head; the throttle valve in it is incorporated in a movable housing which is moved by an eccentric relative to the two-membrane unit; the rigid centers of the unit membranes are connected by a fixed rectangular frame with rods, on the lower of which acts a compensating membrane (or other sensing element), pressed between the moving housing of the throttle valve and the cover. Author (TAB)

N70-20593*# Whittaker Corp., San Diego, Calif. Advanced Composites Engineering.

RESEARCH STUDY TO DEVELOP MEANS OF MANUFACTURING BONDING CLIPS, BRACKETS AND JOINTS, AND PRESSURE SEALING JOINTS WITH UNIFORM STRESS DISTRIBUTION Final Report, 29 Feb. 1968 – 1 Jul. 1969

Harold A. Evensen 25 Sep. 1969 153 p refs
(Contract NAS8-21380)
(NASA-CR-108973) Avail: CFSTI CSCL 13E

Means of attaining uniform light of shear stress distributions in double-lap bonded joints were investigated, and a joint design criterion was developed. For straight-lap, stepped-lap, and scarf joints, this criterion was shown to be independent of adhesive properties and adherend shear stiffness. It was shown that reduction of adhesive peak shear stresses can be accomplished if several general design rules are followed. Full exploitation of these reduced peak shear stresses further requires that the shear strengths of the adherends and the adherend-to-adhesive interfaces exceed that of the adhesive. The unique tailoring capabilities of fiber composite materials were shown to be applicable in realizing valid, optimum designs suggested by the design criterion. With judicious choice of layup patterns, joint strength was shown to be improved without affecting the geometry of the stepped-lap or straight-lap configurations. Procedures Ruderman-Kittel-Kasuya-Yoside tailoring composite adherend properties are discussed. Author

N70-20600# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

SPINDLE GROWTH COMPENSATION SYSTEM FOR NUMERICALLY CONTROLLED LATHES

H. P. Prewett and C. H. Thompson 4 Nov. 1969 26 p refs
(Contract W-7405-eng-26)
(Y-1097) Avail: CFSTI

An automatic spindle-growth compensation system has been developed and installed on a numerically controlled lathe, equipped with a machine tool control unit, at the Oak Ridge Y-12 Plant. An air gage was selected to continually monitor spindle growth and supply a proportional electrical output signal through interface electronics to the lathe control unit. Test results demonstrated that uncompensated spindle growth will have a direct effect on the length dimensions of a workpiece, and the system will maintain the carriage in its programmed position relative to the spindle within + or – 100 microinches over a six-mil range of spindle growth. Author (NSA)

N70-20631*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FRICTION AND CONTACT RESISTANCE FOR LOW-SPEED GALLIUM-LUBRICATED SLIDING ELECTRICAL CONTACTS OF BERYLLIUM IN VACUUM

John S. Przybyszewski Washington Mar. 1970 23 p refs
(NASA-TN-D-5706; E-5375) Avail: CFSTI CSCL 11H

Gallium was used as a lubricant for sliding electrical contacts of beryllium. The gallium was applied to the disk either by swabbing or ion plating. Experimental results show that both the swabbed and ion-plated gallium films reduce the friction from 0.5 (Be against Be) to 0.25. Gallium increases the wear scar diameter by a factor of 1.5 for the swabbed film and by 2.5 for the ion-plated film. The swabbed film is more effective in reducing the electrical noise, whereas the ion-plated film is more effective in reducing the contact resistance. A 500-hr test at 20 A dc with the ion-plated films resulted in a noise level of only 0.01 ohm peak-to-peak after the contact had accumulated about 2 hr of running time. The 500-hr wear scar diameter was greater than the 2-hr wear scar diameter by the factor of only 1.1. Author

N70-20633 National Lending Library for Science and Technology, Boston Spa (England).

STRUCTURAL MODIFICATIONS CAUSED BY WEAR IN GRAPHITE MATERIALS

L. P. Cricorenko et al 17 Dec. 1969 7 p refs Transl. into ENGLISH from Akad. Dokl. Nauk SSSR, Tekhn. Fiz. (USSR), v. 160, no. 4, 1965 p 807–810
(NLL-RISLEY-Trans-1849-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Powder products of graphite wear showed that the breakdown process is characterized by structural modification with mutual disorientation of the crystal layers leading to degraphitization. Two types of wear were studied: (1) graphite crystal Microfilms: at the friction surface with basal planes oriented parallel, a low coefficient of friction, and slight wear; and (2) a high friction coefficient with intensive wear and an absence of oriented layers. Different counter-body metal effects of graphite breakdown were evaluated during intensive wear in a vacuum. Results show that azimuthal disorientation of graphite lattices and mutual layer displacement occur from friction and wear. J.A.M.

N70-20673 National Lending Library for Science and Technology, Boston Spa (England).

METHOD OF GRAPHICAL CALCULATION OF FLUIDIZED DRYING [METODA GRAFICZNA OBLICZANIA SUSZENIA FLUIDYZACYJNECO]

J. Ciborowski [1961] 10 p refs Transl. into ENGLISH from Chemia Stosowana, (Russian), v. 1, no. 1, Ser. B, 1964 p 35-43
(NLL-RTS-5559) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

It was found that in a fluidized drier a state of equilibrium is reached between the outgoing air and the solid material leaving the drier. A method based on this finding is presented for determining the actual equilibrium curve for the adiabatic process. A graphical method is also given for calculating single- and multistage continuous, as well as batch driers. Author

N70-20675 National Lending Library for Science and Technology, Boston Spa (England).

A NEW CENTRIFUGAL FORCE LABORATORY AIR CLASSIFIER WITH A WIDE SEPARATING RANGE

O. Lauer 7 Nov. 1969 16 p refs Transl. into ENGLISH from Chim.-ing-Techn., v. 41, no. 8, Apr. 1969 p 491-496
(NLL-Trans-1078-(9022.27)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

A centrifugal force laboratory air classifier with rotating zigzag-shaped grooves was developed for particle size analysis and preparatory work. The apparatus has a wide separating range between about 1.5 and 80 micro m for materials with a density of 2.7. The capacity is about 0.5 to 3 kg/h according to the trickling ability of the feed. Quantities on the order of 1 kg may be separated quickly. The desired separation limit is set up by varying the number of cog revolutions, and the quantity of air with the aid of a calibration curve. The separating efficiency and reproducibility are good; it is also possible to separate difficult materials which have a great tendency to precipitate and to agglomerate. Author

N70-20695# Bureau of Mines, Minneapolis, Minn. Metallurgy Research Center.

AN EVALUATION OF VARIABLES IN BASIC OXYGEN STEELMAKING

V. R. Spironello, H. A. Tucker, and W. C. Hill Feb. 1970 40 p refs

(BM-RI-7345) Avail: Issuing Activity

Operating variables affecting the efficiency of the basic oxygen furnace (BOF) and the level of contaminating elements in the steel product were investigated. Steel was made in a 400-lb-capacity BOF designed to rotate on its vertical axis to increase the area of hot metal surface subject to oxygen attack. Hot metal for the BOF was made by melting pig iron and scrap in an 18-inch cupola. The variables were BOF speed of rotation, rate of oxygen flow, number of jets and angle at which they were machined into the oxygen-lance tip, temperature of hot metal, reactivity of lime, and temperature of scrap for the BOF charge. Experiments were arranged according to a two-level fractional-factorial design. The effects of the seven variables were evaluated for 13 responses. The greatest ingot yield occurred while using the larger angle lance tip and jets. The most carbon burned per unit volume of oxygen resulted from rotating the BOF and using the smaller angle lance tip. The largest sulfur transfer to the slag occurred at the higher hot metal temperature levels and higher rate of oxygen flow. Author

N70-20714*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CRYOGENIC FEEDTHROUGH Patent Appl.

Edward J. Roberts, inventor (to NASA) Filed 20 Oct. 1969 8 p

(NASA-Case-LAR-10031-1; US-Patent-Appl-SN-867651) Avail: CFSTI CSCL 13K

A penetration unit is described for transferring liquid cryogenics from a source through the chamber wall of a vacuum system to a cryopanel. Liquid nitrogen can be transferred without the time-consumption and expense of modifying the chamber as required for presently available penetrators of this type. NASA

N70-20718*# Sperry Rand Corp., Huntsville Ala. Space Support Div.

DEVICE FOR HANDLING PRINTED CIRCUIT CARDS Patent Appl.

Ronald L.West, inventor (to NASA) Filed 16 Dec. 1969 16 p

(NASA-Case-MFS-20453; US-Patent-Appl-SN-885594) Avail: CFSTI CSCL 13I

A device is described for removing printed circuit cards from a container, such as a computer control box, comprising a tool having an end mechanism for engaging an adapter provided on the end of each printed circuit card. The tool firmly interlocks with the card adapter while simultaneously unlatching a spring loaded latch that secures the card in the container. Use of the tool permits removal, handling, and replacement of printed circuit cards with the use of one hand. NASA

N70-20720*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SELECTIVE NICKEL DEPOSITION Patent Application

Warren H. Philipp, Stanley J. Marsik, and Charles E. May, inventors (to NASA) Filed 13 Nov. 1969 7 p

(NASA-Case-LEW-10965-1; US-Patent-Appl-SN-876588) Avail: CFSTI CSCL 13H

A process for selectively depositing nickel by irradiating selected portions of a substrate coated with an irradiation sensitive compound is described. A suitable substrate coated with nickel hypophosphite is irradiated to cause a chemical change. Nickel is deposited only on the irradiated areas by immersing the substrate in a developing solution. The density of the nickel deposit is a function of irradiation dose within a particular dose range. The process is particularly directed to an improved photographic process and to an improved process for making printed circuits. NASA

N70-20721*# North American Rockwell Corp., Los Angeles, Calif.

LATCHING MECHANISM Patent Appl.

Jacob C. Cobin and Leo L. Rhodes, inventors (to NASA) Filed 21 Nov. 1969 33 p

(Contract NAS9-150)

(NASA-Case-MSC-15474-1; US-Patent-Appl-SN-878731) Avail: CFSTI CSCL 13E

An automatic docking ring latch for latching together the command module and the lunar module of the Apollo spacecraft is described. The latch consists of a latching hook connected to a stored energy power package through a rotatable shaft. Through an automatic gear shift arrangement connecting the cocking handle to the power package, it is possible with less than forty pounds of input force to automatically store a draw down force of over 3,000 pounds with hook movement of .15 inches. A sequential trigger arrangement provides proper hook position before the energy is released. The latch provides fully automatic actuation and preload on initial docking with sufficient hook travel to allow for lunar module ring distortion and tolerance accumulation. Two strokes of the cocking handle releases the latch and automatically reloads it for subsequent operation. NASA

N70-20728*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

ELECTRO-MECHANICAL CONTROL ACTUATOR SYSTEM Patent Application

Hubert F. A. Tschunko, inventor (to NASA) Filed 7 Nov. 1969 19 p

(NASA-Case-ERC-10022; US-Patent-Appl-SN-874733) Avail: CFSTI CSCL 13I

A motion transmitting device utilizing a double differential screw principle is disclosed. One differential screw mechanism including first and second sets of threads of different pitch is operatively coupled to another differential screw mechanism having third and fourth sets of threads of different pitch. By providing the first and second sets of threads with a pitch difference not equal to the difference in pitch between the third and fourth sets of threads, a double differential movement is established. NASA

N70-20740*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SHOCK ABSORBER Patent Application

Earl R. Collins, Jr., inventor (to NASA) Filed 15 Sep. 1969 12 p

(Contract NAS7-100)

(NASA-Case-NPO-10671; US-Patent-Appl-SN-857967) Avail: CFSTI CSCL 13I

A shock absorber is described which is suitable for use as a protective barrier in an impact energy absorbing system, and is characterized by the utilization of a myriad of contiguous spheres arranged in multiple strata for absorbing forces developed on impact. A feature of the shock absorber is employment of a brittle material in the fabrication of the spheres, whereby payload rebound is inhibited and impact force dissipation is enhanced through a sequential fracture and collapse of successive strata of spheres. NASA

N70-20808# Australian Aeronautical Research Committee, Melbourne.

A TENSILE STRESSING ATTACHMENT FOR THE PHILIPS VERTICAL X-RAY DIFFRACTOMETER

R. A. Coyle Jul. 1969 9 p refs *Its* Met. Note No. 67

(ARL/MET-67) Avail: CFSTI

An attachment for the Philips vertical X-ray diffractometer enables X-ray diffraction patterns to be recorded from a specimen under known stress. It has been designed for use in the plastic region of the stress–strain curve and the maximum applied load is 900 Kg. The specimen alignment device is described and performance accuracies are given. Author

N70-20819# California Univ., Livermore. Lawrence Radiation Lab.
TITANIUM WIRE FOR SUBLIMATION PUMPS TO BE USED IN AN ULTRAVACUUM
C. Biguenet, A. M. Shroff, Ph. Mathiaz, and J. Borossay Jul. 1969 10 p refs Transl. into ENGLISH from Vide, (Saine), v. 23, no. 133, 1968 p 15–20
(UCRL-Trans-10354) Avail: CFSTI

Sublimation of titanium wire in order to obtain a getter film is attended by the release of gases, among them hydrocarbons and a great quantity of argon. Hydrocarbons result from the wiredrawing of titanium, and argon comes from the metallurgic processing of the metal. In order to avoid this gas release, especially that of argon which appears every time the metal is sublimed, it is proposed that a tungsten wire coated with titanium obtained by vapor-plating (pyrolysis) be used. The optimum conditions for the deposition are given, as well as the analysis of gases released during the sublimation. Author (NSA)

N70-20868*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLID-STATE WELDING OF DISPERSION-STRENGTHENED MATERIALS
Thomas J. Moore *In its* Aerospace Structural Mater. 1970 p 119–134 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 13H

The potential of two solid-state welding processes was evaluated for joining the dispersion-strengthened materials thoriated nickel (TD-Ni) and thoriated nickel +20-percent chromium (TD-NiCr). Butt joints in sheet material were made by hot isostatic pressure (HIP) welding and by magnetic force upset (MFU) welding. HIP welding was accomplished with two different sets of parameters: 1500 F at 30 ksi for 3 hours, and 2000 F at 20 ksi for 2 hours. Only microdeformation occurred at the weldment. In the MFU welding process, the faying surfaces were resistance heated, with welding accomplished by upsetting of the joint. Joint upset was generated by a forging blow from an electromagnet. Welding required about 1/10 second. Joint efficiencies of the butt weldments were determined in 2000 F tensile tests. Under these conditions, TD-NiCr HIP welds were 100 percent efficient. HIP welds in TD-Ni exhibited about 90-percent efficiency. TD-Ni joints made by the MFU welding process were about 80 percent efficient. MFU welds in TD-NiCr were 56 percent efficient. Author

N70-20891 National Lending Library for Science and Technology, Boston Spa (England).
WHAT THE CONSTRUCTOR AND OPERATOR OF HYDROSTATIC DRIVES OUGHT TO KNOW ABOUT HYDRAULIC OIL AND ADAPTATION TO THE REQUIREMENTS OF THE DRIVE
H. Dietterle 17 Dec. 1969 18 p refs Transl. into ENGLISH from Schmiertech. and Tribologie (West Ger.), v. 15, no. 4, Jul.-Aug. 1968 p 185-190
(NLL-Trans-1160-(9022.9)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Outlined are the desirable characteristics of hydraulic oils and processes for adaptation to specific drive requirements. At high working pressures, the compressibility of the hydraulic fluids, and the possible effects of air bubbles on it, must be taken into account when evaluating the desired viscosity for a particular drive. By considering maximum starting viscosity, minimum operating viscosity, the viscosity temperature behavior of the oil and the temperature range accessible in the individual drive, the range of environmental temperatures that can be tolerated without heating or cooling can be estimated. On changing over to anhydrous synthetic hydraulic fluids, the accessible temperature range may diminish, so that in certain circumstances heating or cooling must be provided. G.G.

N70-20976# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plant Div.
ULTRASONIC INSPECTION OF WELDS WITH MORE THAN 500 mm SIZE
J. Prepechal Sep. 1969 19 p
(ZJE-51) Avail: CFSTI

The ultrasonic inspection of welds with more than 500 mm in size can be carried out using most principles which are used in control of smaller welds. At the same time, new problems arise, which can be solved on present stage of crack detection in control of welds of about 1000 mm. This limit represents also the limit of electroslag welding possibilities. There is the lack of practical experience which is necessary in ultrasonic crack detection. The concepts discussed could help in further solution of this very complicated technical problem. Author (NSA)

N70-21062# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WELDING OF NEW HIGH-STRENGTH MATERIALS
I. A. Gedovyus et al 3 Sep. 1969 162 p refs Transl. into ENGLISH from the Russian
(AD-697685; FTD-HT-23-01-69) Avail: CFSTI CSCL 13/8

Contents: One-sided automatic welding of high-strength steels in a carbon dioxide medium; Methods of preventing cracks in joints welded in steel 25KhGSA; Automatic welding of high-strength steels with transverse vibrations of the electrode; Reclaiming dies by the facing method; High-frequency-arc welding of high-strength sheet steels; Experience with projection welding of ball-bearing retainers; Automatic welding of special steel and alloy valve assemblies; Molten-slag arcless electric remelting of high-speed steels; Automatic control of arc length in welding high-strength steel products; Improvement of work organization in the molten-slag arcless electric welding section; Properties of welded joints in V92 alloy; Diffusion welding of unlike metals; Improvement of the process of cutting aluminum alloys with a pinched arc; Brazing of titanium-alloy structures with thermovacuum coatings; Argon-shielded welding of aluminum alloys with a three-phase arc; Means of increasing precision in structures welded from AMg6 alloy; Welding in controlled-atmosphere chambers with repeated use of the shielding gas; Equipment for electrolytic polishing and quality control of wire conditioning prior to welding; Automatic argon-shielded-arc welding employed for production of thin-walled alloy AMg6 vessels; Television monitoring of shielded-arc welding; and Projection attachment for observation of the welding process. TAB

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-20201# Illinois Univ., Urbana. Gaseous Electronics Lab.
STUDIES OF LOW DENSITY PLASMAS WITH GAS LASERS Interim Report, 1 Jul. 1966 - 1 Jul. 1969
J. T. Verdeyen and B. E. Cherrington Sep. 1969 96 p refs
(Contract AF 33(615)-5248)
(AD-697997; ARL-69-0149) Avail: CFSTI CSCL

The report describes many of the uses of the gas laser to study the refractive index of a plasma. It is shown that the sensitivity of the laser interferometer can be greatly enhanced by utilizing the transverse modes of an external spherical cavity. The parameters that determine the sensitivity of a spherical laser interferometer are discussed, and detailed theory of such is given. The plasma to be studied can be located in the external cavity or inside the laser cavity. The latter geometry preserves the excellent spatial resolution of the laser and also the high sensitivity of the spherical geometry. In order to achieve even higher sensitivity to very small changes in plasma refractivity, the laser heterodyne

system was evolved. This was applied at the three common He:Ne laser wavelengths of 0.6328 microns, 1.15 microns, and 3.39 microns. The latter transition is especially attractive because of its high gain and inherent sensitivity to the presence of the free electrons in a plasma. However, mode pulling effects at 3.39 microns are quite serious and a technique has been developed to evaluate it. Author (TAB)

N70-20210 Pennsylvania State Univ., University Park.
AMPLIFICATION PROPERTIES OF THE 3s 2-2p 4 NEON TRANSITION (6328 ANGSTROM) IN HELIUM-NEON GAS MIXTURES
Richard Allen Mollo (Ph.D. Thesis) 1968 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-5576

The major objective of this study was to investigate experimentally the unsaturated gain (gain factor) of the 3s2-2p4 transition (6328A) of neon in a helium-neon discharge. In addition to extensive quantitative gain factor measurements taken under well-controlled experimental conditions, an analysis of important excitation and de-excitation phenomena is presented. The results of this analysis point out the important role radial diffusion flow processes have in determining the peak gain attainable at this transition as well as in setting the gain saturation characteristics. Dissert. Abstr.

N70-20264 Cornell Univ., Ithaca, N.Y.
NEON FINE STRUCTURE STUDIED BY GAS LASER SPECTROSCOPY
Thomas Frazier Johnston, Jr. (Ph.D. Thesis) 1968 259 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.35 Order No. 69-7287

The energy separation and properties of the fine structure levels in neon have been studied using the difference frequency resonance technique. Spectroscopic techniques, involving the laser action, for the measurement of atomic parameters, in particular the relative level populations, are used in order to complete the analysis since in the large field limit the line shapes depend on the relative level populations. Some discussion and correction of a related (microwave spectroscopy) experiment on this fine structure pair is given. Dissert. Abstr.

N70-20388# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
INFRARED DETECTORS LASER TECHNOLOGY AND SIGNAL PROCESSING Annual Report, 1 Sep.1968-30 Aug. 1969
R. J. Collins 30 Sep. 1969 119 p refs
(Contract N00014-68-A-0141-0002)
(AD-698153; AR-2) Avail: CFSTI CSCL 20/5

Contents: Photoelectric detection; Radian gain profiles in a CO2 amplifier; CO2 laser plasma studies; Raman scattering; Signal processing; Noise in optical detection; and Semiconductor noise investigations using microwaves. Major strides have been made in the area of the understanding of the failure mode of sealed CO2 lasers, in the understanding of photocathode formation process and the measurement of gain profiles in CO2 laser tubes. TAB

N70-20451 National Lending Library for Science and Technology, Boston Spa (England).
DIFFRACTION AT A RUBY LASER PUMPED WITH STANDING LIGHT WAVES
H. Boersch et al Oct. 1969 7 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 22, no. 5, 1967 p 378–379
(NLL-CTO/664-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A ruby was pumped optically by a standing lightwave. The resulting spatial modulation in the populations of the ground and excited state was detected by the diffraction of a second lightwave. The time necessary for the spatial distribution to be smoothed out was measured. Author

N70-20788*# Stanford Univ., Calif. Microwave Lab.
INVESTIGATION OF LASER DYNAMICS, MODULATION AND CONTROL BY MEANS OF INTRA-CAVITY TIME VARYING PERTURBATION Quarterly Status Report, 1 Nov. 1969 –31 Jan. 1970
Feb. 1970 22 p refs
(Grant NGL-05-020-103)
(NASA-CR-108787; SU-ML-1831; QSR-9) Avail: CFSTI CSCL 20E

Progress in obtaining tunable optical sources by means of nonlinear optical techniques is given. Work done is summarized in topics covering: pulse lengthening via overcoupled internal second harmonic generation, electronic tuning and short pulsing of dye lasers, laser stabilization, and backward wave oscillation. J.M.C.

N70-20771*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENERGY LEVELS AND TRANSITION MATRIX ELEMENTS OF PARAMAGNETIC CRYSTALS FOR MASER APPLICATIONS
Robert W. Berwin 1 Mar. 1970 20 p refs
(Contract NAS7-100)
(NASA-CR-109124; JPL-TM-33-448) Avail: CFSTI CSCL 20E

Computer programs on the Univac 1108 have been developed at the Jet Propulsion Laboratory to give the energy levels and transition probabilities for ruby, emerald, iron-doped rutile, iron-doped zinc tungstate, and chromium-doped rutile. These programs also generate SC-4020 plots of energy levels vs an external dc magnetic field which is at any orientation with respect to the crystal magnetic axes. Author

N70-20897# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALL UNION CONFERENCE ON INFORMATION RETRIEVAL SYSTEMS AND AUTOMATED PROCESSING OF SCIENTIFIC AND TECHNICAL INFORMATION: SELECTED ARTICLES [VSESOYUZNAYA KONFERENTSIYA PO INFORMATSIONNO POISKOVYM SISTEMAM I AVTOMATIZIROVANNOY OBRABOTKE NAUCHNO-TEKNICHESKOY INFORMATSII]
1 May 1969 30 p refs Transl. into ENGLISH from Tech. Devices of Inform. Serv. and Duplicating Tech. (Moscow), 1967 p 96-109 Presented at Moscow
(AD-696048; FTD-MT-24-56-69) Avail: CFSTI CSCL 9/2

Contents: Means of the application of lasers in permanent photoscopic memory units; Criterion of estimating the quality of optical systems. TAB

N70-20915# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICS AND CHEMISTRY OF PROCESSING MATERIALS (SELECTED ARTICLES)
A. N. Iyerusalimskaya et al 17 Jun. 1969 20 p refs Transl. into ENGLISH from Fiz. Khim. Obrabotki Materialov (USSR), no. 4, 1968 p 26-43
(AD-695919; FTD-MT-24-112-69) Avail: CFSTI CSCL 20/5

Contents: Structural changes in a substance under the influence of light laser pulses; Local case hardening of steel using laser radiation. TAB

N70-20948# McDonnell-Douglas Co., St. Louis, Mo.
THE SECOND CONFERENCE ON CHEMICAL AND MOLECULAR LASERS
D. P. Ames, W. Q. Jeffers, and J. E. Wollrab Sep. 1969 73 p refs Conf. Presented at St. Louis, 22-24 May 1969
(Contract DAAH03-69-C-0436)
(AD-696255; AFOSR-69-2612TR) Avail: CFSTI CSCL 20/5

The conference was an open international meeting where new basic research findings were presented and discussed. The six sessions of the conference addressed the following topics: (1)

detonation initiated chemical lasers, (2) carbon dioxide lasers, (3) infrared lasers employing hydrogen, (4) near infrared tri-atomic molecular lasers, (5) pumping processes, and (6) lasing processes and techniques. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-19729*# Martin Marietta Corp., Denver, Colo.
CRYOGENIC ALLOY SCREENING Interim Report
F. R. Schwartzberg, R. D. Keys, and T. F. Kiefer Feb. 1970 233 p refs
(Contract NAS3-11203)
(NASA-CR-72617) Avail: CFSTI CSCL 11F

Three materials, 2021-T81 and X7007-T6 aluminum alloys and cryogenically stretched 301 stainless steel, were evaluated in order to determine their mechanical properties, static fracture toughness, cyclic flaw-growth behavior and sustained load threshold stress intensity. Testing was performed for both parent metal and welded material at 70, −320, and −423 F. Surface flaw and compact tension specimens were used for the fracture mechanics portion of the evaluation. The results showed that the two aluminum alloys were quite tough. The 2021-T81 alloy is not greatly superior to 2014-T6 from a strength standpoint, but may be desirable from a weldability standpoint. X7007-T6 exhibits excellent static and cyclic strength properties but appears to have a low threshold. The cryogenically stretched stainless steel exhibits an excellent combination of properties. Additional work to further characterize the aluminum alloys was defined and is currently being performed in the continuing effort. Author

N70-19791*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
CRYOGENIC RESEARCH AND DEVELOPMENT Progress Report, Period Ending 31 Dec. 1969
31 Dec. 1969 13 p
(NASA Order R-06-006-003; NBS Proj. 27500-2750400; NBS Proj. 27502-2750420; NBS Proj. 27503-2750430; NBS Proj. 27503-2750439 et al NBS Proj. 27505-2750451)
(NASA-CR-108238; NBS-9750; PR-36) Avail: CFSTI CSCL 11F

Measurements on the cryogenic properties of solids are briefly described. Thermal conductivity measurements were made on austenitic stainless steel, and preliminary indications are that the steel will make a low conductivity, low temperature standard reference material. Electrical resistivity measurements were made on four iron specimens. Data on thermal diffusivity of graphite and electrical resistance of pure copper are graphed as functions of temperature. N.E.N.

N70-19794# Junta de Energia Nuclear, Scavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares.
DETECTING DISLOCATIONS IN NIOBIUM BY THE METHOD OF PIT-ETCHING [REVELACAO DE DESLOCAMENTOS EM NIOBIO PELO METODO DAS FIGURAS DE ATAQUE]
J. M. da Cunha Monteiro and H. Carvalhinhos 1969 30 p refs In PORTUGUESE
(LFEN-99/alpha/) Avail: CFSTI

The effects of temperature and time on the speed of decreasing dislocation density of niobium deformed by cooling is studied, and a technique is established for revealing the dislocations by electrolytic solution. The influence of the crystal orientation on the conditions for detection is verified, and the preparation of the test conditions for obtaining the maximum information possible concerning the density and distribution of the dislocations are described. Transl. by F.O.S.

N70-19802# United Kingdom Atomic Energy Authority, Harwell (England).
EFFECT OF HIGH PRESSURES ON THE ELECTRICAL CONDUCTIVITY OF PRASEODYMIUM AND SOME PRASEODYMIUM ALLOYS
E. King and I. R. Harris May 1969 17 p refs
(AERE-R-5965) Avail: CFSTI

High-pressure resistivity studies on praseodymium have shown that there is a maximum in the resistance at a pressure of about 40 kB, and high-pressure X-ray diffraction work has shown that this resistance anomaly is associated with a crystallographic transformation from a double-hexagonal to a fcc modification. A study was made of the effect on this behavior of alloying additions of the trivalent rare-earth elements gadolinium, terbium, holmium, and yttrium, and the tetravalent actinide metal thorium, all of which form extensive solid solutions in praseodymium. It was found that the hcp rare-earth metals increase the pressure at which the resistance maximum occurs, stabilizing the dihexagonal structure relative to the fcc form. Face-centered-cubic thorium lowers the pressure at which the resistance maximum occurs, increasing the relative stability of the fcc praseodymium allotrope. Author (NSA)

N70-19900# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
NOTCHED HIGH-STRAIN FATIGUE BEHAVIOR OF THREE LOW-STRENGTH STRUCTURAL STEELS
E. Krempl Jan. 1969 41 p refs
(Contract AT(04-3)-189)
(GEAP-5714) Avail: CFSTI

The high-strain fatigue behavior of three notched low-strength structural steels was investigated. Grooved cylinders with uniaxial elastic stress concentration factors of 3.3 were tested at room temperature under completely reversed, load-controlled conditions. The axial and transverse cyclic strains were measured in the root of the notch, using 1/64-inch strain gages. Fatigue crack initiation and final failure were determined. Variations in the notch root strain range with cycling are significant above about 1.4 percent and reflect the cyclic strain-hardening characteristics of the steels. It was determined that fatigue strength reduction factors can be higher than 3.3. Crack growth lives computed from striation density measurements compared reasonably well with observed crack growth lives of Type 304 stainless steel and carbon lives of Type 304 stainless steel and carbon steel. Separation of the specimens occurs when the true stress is around the true ultimate tensile strength of the steels. Author (NSA)

N70-19996 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF VARIOUS FACTORS ON THE VALUE OF THE CREEP INDEX [VLIYANIE RAZLICHNYKH FAKTOROV NA VELICHINU POKAZATELYA POLZUCHESTI]
A. A. Chizhik Jan. 1970 12 p refs Transl. into ENGLISH from Energomnshinostr. (Moscow), no. 2, Feb. 1969 p 28–31
(NLL-RTS-5340) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupons

The effects of temperature, time, and grain size on the creep index of heat resistant materials were investigated. Relaxation tests with resilient links were used to determine the creep index and to establish a quantitative connection between the temperature dependence of the index and the activation energy of the process as a whole. Findings are: (1) Steels and alloys show a creep index linear dependence on the inverse value of absolute temperature. (2) Two steels tested at high temperature and low speed of deformation did not show any dependence of creep index on test

duration. (3) The steel creep index is dependent on grain size, but with pure copper this dependence is not well defined. (4) A link between the creep index and value of activation energy was established. D.L.G.

N70-20081# United Kingdom Atomic Energy Authority, Harwell (England). Atomic Energy Research Establishment.
DETERMINATION OF CARBON IN STAINLESS STEELS
D. J. Wicks and I. G. Jones Jul. 1969 13 p refs
(AERE-AM-110) Avail: CFSTI; UK 2s 6d

The sample is ignited in O2 at 1600 C using a resistance heated furnace and Al2O3 boats. ZrO2 powder is added to prevent attack on the furnace tube by the reacting sample. Evolved CO2 is collected by condensing at liquid O2 temperature and its amount is measured manometrically. Sample weights from 0.5 to 0.010 g were used, and weights of carbon determined varied from 5 to 400 micrograms. NSA

N70-20133 Syracuse Univ., N.Y.
THE DETERMINATION OF THE ABSOLUTE VISCOSITY OF SOME METALS AND ALLOYS BY AN OSCILLATING CUP VISCOMETER
Richard Paul Colburn (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-7729

The absolute viscosities of mercury, tin, lead and several alloys of the lead-tin and bismuth-tellurium systems were measured using an oscillating cup viscometer. The viscometer also served as a pycnometer which gave accurate densities of the liquid alloy samples at the maximum temperature to which they were raised. The exact compositions of the alloys were determined from these densities in the liquid state. The viscosity of mercury at 20.0 C was found to be 0.01551 poise, which is in excellent agreement with results obtained using capillary methods. The viscosity of lead, tin and nine of their alloys were measured as a function of temperature between the liquids and 500 C. The viscosity of pure tin ranged from 0.01780 poise at 235 C to 0.01196 poise at 458 C. The viscosity of pure lead ranged from 0.02578 poise at 334 C to 0.01898 at 472 C. Viscosity isotherms, as a function of composition, showed an ideal linear behavior. Dissert. Abstr.

N70-20155# Atomic Weapons Research Establishment, Aldermaston (England).
SURFACE SPRAY FROM EXPLOSIVELY ACCELERATED METAL PLATES AS AN INDICATOR OF MELTING
W. F. Bristow and E. F. Hyde Sep. 1969 31 p refs
(AWRE-O-56/69) Avail: CFSTI

The various forms of spray emanating from the surface of explosively accelerated metal plates are described and possible sources suggested. It is concluded that the occurrence of some of the visible features depends on the metal being molten and that it is therefore possible to obtain evidence of the state of the metal from high speed dynamic photographs. NSA

N70-20180# Institut Franco-Allemand de Recherches, St. Louis (France).
INVESTIGATIONS OF STEEL SAMPLES ERODED BY EXPLOSIVE POWDER GASES [UNTERSUCHUNGEN AN DURCH PULVERGASE ERODIERTEN STAHLPROBEN]
C. Jessen 21 Jun. 1968 40 p refs In GERMAN
(ISL-T-23/68) Avail: CFSTI

Experimental erosive bomb studies were performed on nozzles made from standard CrNiMo4 steel as well as from technically pure iron. The corrosive effects of streaming hot gases from various explosive powders at differing degrees of charge densities were evaluated by metallographic analyses of the nozzle's longitudinal cross sections. Standardized steel exhibited with all explosive charges and pressures a remarkable discoloration and hardening in the vicinity of the nozzle rim; however, its fine structure prevented the microscopic resolution and analysis of the effects. The ferritic base in the pure iron helped to analyze localized structural effects, especially of increased hardness. A chemical effect of the streaming hot gases was indicated together with observed fracture formation and erosion. Identification of minute particles with metallurgical methods was not obtained. The erosive processes of the exploding powder gases seem to be thermal-chemical-mechanical. Transl. by G.G.

N70-20270 Stanford Univ., Calif.
REFORMULATION OF THE MODEL POTENTIAL THEORY OF SIMPLE METALS
Robert William Shaw, Jr. (Ph.D. Thesis) 1968 367 p
Avail: Univ. Microfilms: HC $16.65/Microfilm $4.70 Order No. 69-8264

In the model potential theory of simple metals, as in pseudopotential theory, the fundamental idea is to replace deep ion core potentials by shallow model potentials without altering the energy of electronic states. The theory included several untested assumptions, and the energy dependence of the potential was overlooked in determining the self-consistent screening. Two modifications have been made in the construction of the model potential. A different model radius has been chosen for each angular quantum number, and the core potential has been modeled only for those angular momenta for which there are core states. These changes introduce sufficient flexibility in the potential to permit a variational optimization which gives the smoothest possible model wavefunctions. It can be shown that this optimization procedure is internally consistent only if both of the suggested modifications of the potential are made. Dissert. Abstr.

N70-20272 North Carolina State Coll., Raleigh.
THE EFFECT OF FIBER ORIENTATION ON THE FATIGUE PERFORMANCE OF FIBER REINFORCED COMPOSITE MATERIALS
Vernon Leon Goodwin, Jr. (Ph.D. Thesis) 1969 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-7661

The performance of metal matrix-metal fiber composite systems under conditions of fatigue loading have been both analytically and experimentally investigated. All composite materials used for these tests were fabricated by reinforcing hot-pressed titanium or Hastelloy X matrices with 10 mil tungsten or molybdenum wires. The titanium matrix specimens employed 22 per cent by volume molybdenum wires while the Hastelloy X matrix specimens employed 35 per cent by volume of either tungsten or molybdenum wires. Filament orientation angles of 0, 10, 45, and 90 degrees with respect to the axis of loading were employed for the titanium matrix specimens while angles of 0, 30, 60, and 90 degrees were tested in Hastelloy X matrix specimens. In all cases the fatigue strength was found to decrease with increasing angularity between the filament orientation axis and the axis of loading. The extent of this strength loss was found to be greatest in those systems employing greatest volume percentage of rigid reinforcing filaments. Dissert. Abstr.

N70-20299# Naval Research Lab., Washington, D.C. Reactor Materials Branch.
HEAVY SECTION STEEL TOUGHNESS CHARACTERIZATION Progress Report, Period Ending 31 Aug. 1969
Frank J. Loss 15 Sep. 1969 21 p refs
(AD-687920; NRL-MR-2041) Avail: CFSTI CSCL 11/6

An investigation was made of the fracture toughness of thick-section steels as influenced by mechanical constraint and through-thickness metallurgical variations. The primary tool used in these research studies is the dynamic tear (DT) test. This progress report includes the following: (1) toughness variation through the

thickness of HSST plate 03, (2) comparison of toughness of 5/8-in. DT specimens (in the RW and WR orientations) cut from HSST plate 02, and (3) thick section DT tests from HSST plate 01. Author (TAB)

N70-20320# Iowa Univ., Iowa City. Mechanical Engineering Dept.
MICROSCOPIC MOVIE OF FATIGUE INDUCED CRACK INITIATION AND PROPAGATION
R. E. Duncan and R. I. Stephens Aug. 1969 9 p refs
(Contract DAAF03-69-C-0014)
(AD-698017) Avail: CFSTI CSCL 11/6

A motion picture taken through an optical microscope was made in an attempt to better understand the mechanisms of fatigue crack initiation, propagation and fracture in metals. The primary usage of the movie is that of a visual educational training aid. The movie qualitatively compares crack initiation and propagation in a low carbon steel under the following conditions: (a) low cycle fatigue (less than 50,000 cycles to failure) photographed at 16X, 150X, and 300X magnification; (b) high cycle fatigue (about 1 million cycles to failure) photographed at 300X magnification. Under these conditions the movie shows the interaction of slip lines, slip bands, crack tip, grains and grain boundaries under cyclic conditions. Author (TAB)

N70-20456# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CAST ALLOYS, VOLUME 1
L. I. Levi and S. K. Kantenik 13 Aug. 1969 398 p Transl. into ENGLISH from the Russian
(AD-698103; FTD-MT-24-461-68-Vol-1) Avail: CFSTI CSCL 11/6

The book reviews in detail the production of casting alloys used in machine building, instrumentation, chemical industry and rocket engineering. Physical-metallurigical basic principles of producing casting alloys and the cast alloy properties are discussed in special chapters. TAB

N70-20469 National Lending Library for Science and Technology, Boston Spa (England).
DIFFERENCES IN THE LOADIBILITY OF HEAVY PLATES RESULTING FROM ANISOTROPY
K. Born et al Sep. 1969 22 p refs Transl. into ENGLISH from Stahl U. Eisen, v. 88, no. 9, 5 Feb. 1968 p 429–439
(NLL-NSTIC-Trans-2026-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

Heavy plates of normalized and heat-treated structural steels were tested for their mechanical properties, primarily on the basis of tensility and notch impact resistivity, the test pieces being taken longitudinally and transversely to the rolling direction and vertically to the rolling surface. The experimentation embraced a heavy plate of rust and acid proof austenitic steel, partially forged, multilayer submerged-arc and manual electric welds as well as forged ingots from an experimental melt. The last-named steels were primarily aimed at discovering the cause of anisotropy. The results showed that the main effect on the variation in the respective mechanical properties of samples taken in the three test directions was from the manganese sulphide exudation present in technical steels. This effect was expressed particularly in the results from aluminiferous fine-grain steels. Agglomerations of manganese silicate in coarse-grain steels may also be a contributory factor. Local anisotropy may also result from exogenous impurities. Despite low sulphur content and good supersonic results, samples from steels whose aluminium content exceeded 0.02% produced unsatisfactory values for plasticity and notch resistivity vertical to the rolling surface. Author

N70-20485*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INVESTIGATION OF FATIGUE-CRACK GROWTH UNDER SIMPLE VARIABLE-AMPLITUDE LOADING
C. Michael Hudson and K. N. Raju Washington Mar. 1970 23 p refs
(126-14-15-01-23)
(NASA-TN-D-5702; L-6834) Avail: CFSTI CSCL 11F

Variable-amplitude fatigue-crack-growth tests were conducted on simple sheet specimens made of 7075-T6 aluminum alloy. The numbers and the amplitudes of the high-load cycles applied in these tests were systematically varied to study their effects in subsequent low-load fatigue-crack growth. The high-load cycles consistently delayed subsequent fatigue-crack growth at lower load levels. For a given low-load level, the higher the preceding high-load level was, the greater the delay in crack propagation. Furthermore, the delay in crack growth increased with increasing numbers of high-load cycles up to a limit. One high-load cycle caused approximately one-fourth of the maximum delay, and ten high-load cycles caused approximately one-half of the maximum delay. These delays probably resulted from residual compressive stresses generated in the material immediately ahead of the crack tip during the application of the high-load cycles. Author

N70-20525# Revere Copper and Brass, Inc., Brooklyn, N.Y.
ALUMINUM AND ALUMINUM OXIDE IN ZERO GRAVITY
L. F. Mondolfo *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 176–182 refs (See N70-20517 08-30)
Avail: CFSTI

An experiment is described to test the feasibility of using absence of gravity to mix immiscible materials. The mixing of aluminum oxide into molten aluminum has been chosen, as representative of the dispersing of immiscible solids into liquids. The equipment planned consists of a small self contained furnace burning a Thermit mixture, which can handle some 100 grs. of metal. A gas operated stirrer will provide the mixing. One of two results is expected: (1) mixing is successful; (2) freezing produces separation. In either case, industrial exploitation is to be expected. Author

N70-20526# TRW Systems Group, Redondo Beach, Calif.
REDUCED GRAVITY PROCESSING OF HOMOGENIZED IMMISCIBLE METAL ALLOYS
J. L. Reger, M. E. Kirkpatrick, and R. L. Hammel *In* NASA Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 183–194 refs (See N70-20517 08-30)
Avail: CFSTI

Reduced gravity material experiments to process and prepare unique metal alloy systems from normally immiscible liquid phase melts are described. The study of this previously unclassified group of materials is considered from several aspects. The effects of low gravity environment on the observed immiscibility limits of two phase liquid combinations are considered. Included are discussions of homogenized alloy processing covering production of materials with unique physical and electrical properties, consideration of basic solidification processes, and the potential application of homogenized alloys in the preparation of composite materials. Potential experiment performance limitations, requirements and interface criteria are identified. Author

N70-20570# Laboratori Riuniti Studi e Ricerche, Milan (Italy).
DEVELOPMENT OF LOW-ALLOY TERNARY URANIUM ALLOYS (U-NB-CR, U-NN-FE, U-NB-NI, U-NB-SI, U-NB-ZR)
M. R. Bastelli, C. D'Amato, R. Renzoni, F. S. Saraceno, and T. B. Wilson Brussels EURATOM 1969 98 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-001-62-6 TEGI)
(EUR-4384.i) Avail: CFSTI

The purpose of the study was to develop uranium alloys with a low addition content whose irradiation behaviour would, if possible, be better than that of adjusted uranium or U-1% Mo alloys. The work on the U-Nb-X ternary alloys included studies

on beta-quenched and tempered U-1%Nb-0.15-0.25% Cr alloys. Laboratory tests showed that these alloys have: (1) good structural stability at 550 C; (2) better mechanical resistance in the cold and in the hot (550 C) state than that of traditional alloys; and (3) better thermal cycling resistance (0-550 C). Creep resistance is higher when the chromium content is low (0.15% Cr). The U-1% Nb-0.15% Cr alloy is to be subjected to in-pile irradiation.
Author

N70-20581 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF STRESS CORROSION OF AUSTENITIC STEELS AND NICKEL ALLOYS
H. U. Borgstedt et al 24 Nov. 1969 15 p refs Transl. into ENGLISH from Kernforschungszentrum Karlsruhe Rept. KFK-812, (Germany), 1968 29 p
(NLL-Trans-746-345-(9022.40)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The known theoretical and experimental knowledge of stress corrosion, emphasizing stress corrosion in nuclear plants, is reviewed, and an experimental investigation is described. Specimens stamped from sheet metal were submerged in a magnesium chloride-water mixture kept at the boiling point, and subjected to tensile stress. The specimens were steels of varying chromium and nickel compositions, and heat resistant steels. Data were obtained on time to fracture, variation of elongation with time, and microstructure of surface and section. These were found to depend greatly on composition, test temperature, and applied tensile stress. It is felt that the results concur with current views on stress corrosion and no relationship between susceptibility to stress corrosion and grain structure is indicated. It is also concluded that nickel content alone is not the decisive factor in resistance to stress corrosion.
N.E.N.

N70-20641 National Lending Library for Science and Technology, Boston Spa (England).
CORROSION AND FOULING: INVESTIGATIONS IN CUXHAVEN
H. Kuehl et al 17 Dec. 1969 10 p refs Transl. into ENGLISH from Schiff und Hafen (German), v. 20, no. 8, 1968 p 548-551 p 548-551
(NLL-NSTIC-Trans-2061-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Several tests were performed on fouling and sea water corrosion at Cuhaxen where a river and sea merge, causing variations in salt content and water temperature. The main barnacle-forming organisms are discussed. Results show that uniform, complete initial fouling hinders corrosion by covering the surface with calcereous plates, thus preventing sea water access.
J.A.M.

N70-20674# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CAST ALLOYS
L. I. Lavi et al 13 Aug. 1969 173 p refs Transl. into ENGLISH of the publ. "Liteynyye Splavy" Moscow, Izd. Vysshaya Shkola, 1967 p 1-435
(AD-697994; FTD-MT-24-461-68-Vol-2) Avail: CFSTI CSCL 11/6

Contents: Copper and its alloys; Nickel and its alloys; Cobalt and its alloys; Castings from refractory and certain other metals and alloys; Aluminum and its alloys; Magnesium and its alloys, Bearing alloys; and Casting from nonmetallic materials.
TAB

N70-20679# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
SELECTION OF ANODE MATERIALS AND OPERATING CONDITIONS FOR ELECTROWINNING BERYLLIUM
D. A. O'Keefe and D. E. Couch Feb. 1970 14 p refs
(BM-RI-7347) Avail: Issuing Activity

The electrowinning of beryllium from beryllium oxide (BeO) using a molten-salt electrolyte composed of 58 LiF-37 BeF2-7 BeO (mole-percent) was investigated. Anodes made of porous carbon were found to be superior in current carrying capacity and gave a lower cell voltage than other types of anode material tested. When porous carbon anodes were used, the resultant increase in anode area prevented anode passivation. The cell voltage was 3.3 volts, and electrode current efficiencies of 50 to 70 percent were obtained. The electrodeposited beryllium was recovered as beryllium powder or was coalesced to metal beads by heating to 1,300 C.
Author

N70-20689*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MASS SPECTROMETRIC DETERMINATION OF THE DISSOCIATION ENERGIES OF TITANIUM DICARBIDE AND TITANIUM TETRACARBIDE
Carl A. Stearns and Fred J. Kohl Washington Mar. 1970 20 p refs
(NASA-TN-D-5853) Avail: CFSTI CSCL 11F

The Knudsen effusion method was used in conjunction with a double-focusing mass spectrometer to study the vaporization of the titanium-carbon system over the temperature range from 2518 to 2790 K. Titanium dicarbide (TiC2) and titanium tetracarbide (TiC4) molecules were identified in the gas phase. Heats of the various equilibrium reactions involved were determined by both the second- and third-law methods. Third-law enthalpies were combined with published thermodynamic data to calculate the atomization energy of TiC2 and TiC4. Comparisons of second- and third-law results are discussed in terms of the ground-state degeneracies selected to make the third law calculations for the dicarbide and tetracarbide molecules.
Author

N70-20682# Bureau of Mines, Boulder City, Nev. Metallurgy Research Center.
ELECTROWINNING ALUMINUM FROM ALUMINUM CHLORIDE: OPERATION OF A SINGLE-COMPARTMENT CELL
D. E. Kirby, E. L. Singleton, and T. A. Sullivan Mar. 1970 27 p refs
(BM-RI-7353) Avail: Issuing Activity

The electrochemical reduction of AlCl3 was investigated as a process for the production of aluminum. An externally heated, single-compartment cell with a rammed refractory lining was used with molten KCl-NaCl-AlCl3 electrolyte. Aluminum was deposited at 700 to 760 C with a current of 100 to 200 amperes on a molten aluminum cathode. Chlorine was evolved at a graphite anode and collected and measured to provide a quantitative evaluation of the AlCl3 reduction. Aluminum was removed from the cell by siphoning or ladling. Granular AlCl3 was added periodically to replenish that depleted from the electrolyte. Concentrations of 7.5 to 17.5 percent AlCl3 in the electrolyte were optimum for operation. Anode current efficiencies of 83 to 85 percent were attained, using anode current densities of 5.9 amperes per square inch and an anode-cathode distance of 4 inches. The chemically bonded, alumina liner was resistant to attack by aluminum and chlorine but susceptible to erosion at the surface of the electrolyte. Titanium diboride proved suitable for the electrical connection to the molten aluminum cathode. Aluminum of a purity equal to or better than 1100 series metal was electrowon continuously from commercial AlCl3 for a period of 4-1/2 months.
Author

N70-20688# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
USE OF CEMENT COPPER IN AN IRON-COPPER-CARBON POWDER METALLURGY ALLOY
Robert L. Crosby, D. H. Desy, and Robert M. Doerr Feb. 1970 18 p refs
(BMRI-7348) Avail: Issuing Activity

The substitution of cement copper powder for commercial

copper powder in an Fe-7 pct Cu-1 pct C powder metallurgy alloy was investigated. Copper powders from six different commercial cementation operations were separately upgraded by screening and hydrogen reduction. They were then mixed with commercial iron and graphite powders to form the Fe-7 pct Cu-1 pct C alloy. Various chemical and physical properties were determined on the upgraded cement copper and the alloy powders. Mechanical, physical, and chemical properties were determined on green and sintered specimens made from the alloy powders. Mean tensile and bending strength of sintered specimens were significantly lower than the means from specimens made from commercial metal powders. The lower strengths are apparently related to poor sinterability. Author

N70-20752*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SULFUR, OXYGEN, AND HYDROGEN SULFIDE SURFACE FILMS ON THE ADHESION OF CLEAN IRON
Donald H. Buckley Washington Mar. 1970 17 p refs
(NASA-TN-D-5689; E-5422) Avail: CFSTI CSCL 11F

Adhesion experiments were conducted with the (011) crystal face of iron in contact with iron. The surfaces were examined clean and with sulfur, oxygen, and hydrogen sulfide present. Both LEED and Auger analyses were used to determine the nature of surface changes that occurred with the adsorption of gases on that surface. Sulfur and hydrogen sulfide afford greater resistance to adhesion of iron to itself that does oxygen with an equivalent surface coverage. The greater the surface coverage with hydrogen sulfide, the lower the force of adhesion. With hydrogen sulfide, three structures were observed: a (2X4), a (1X2), and a full monolayer that had a close packed arrangement. Author

N70-20768*# General Electric Co., Cincinnati, Ohio. Space Div.
COMPATIBILITY OF COLUMBIUM BASE ALLOYS WITH LITHIUM FLUORIDE
R. W. Harrison and W. H. Hendrixson Washington NASA Mar. 1970 61 p refs
(Contract NAS3-8523)
(NASA-CR-1526; GESP-261) Avail: CFSTI CSCL 11F

The compatibility of lithium fluoride with several columbium base alloys was studied by testing capsules under the cyclic thermal conditions which simulate the sun-shade cycle of heat receiver in a 300-nautical mile orbit. Capsules fabricated from columbium alloys containing lithium fluoride were cycled between 1500 and 1900 F up to 5000 hours in a high vacuum environment. Author

N70-20789# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR, INSTITUTE OF METALLURGY. STRUCTURE AND PROPERTIES OF HEAT RESISTANT METAL MATERIALS (SELECTED ARTICLES)
N. N. Kozlova et al 3 Feb. 1969 28 p refs Transl. into ENGLISH from Akad. Nauk SSR Inst. Met. Struktura i Svoystva Zharoprochnykeh Metallicheskiky Materialov (Moscow), 1967 13 p
(AD-694827; FTD-HT-23-741-68) Avail: CFSTI CSCL 11/6

Contents: Principles of prolonged oxidation of heat-resistant steels and alloys, and investigation of duo-component heat-resistant coatings on a silicon base on nickel alloys. TAB

N70-20781# Oak Ridge National Lab., Tenn. Solid State Div.
RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, Period Ending Oct. 1968
Apr. 1969 57 p refs
(Contract W-7405-eng-26)
(ORNL-4369) Avail: CFSTI

Investigations of radiation effects on reactor pressure vessel steels and in iron and vanadium are reviewed. Pressure vessel tasks discussed are: radiation hardening and embrittlement in ASTM A 212-B steel; electron fractography of irradiated A 212-B steel; radiation hardening and embrittlement in ASTM A 533-B steel; and properties of 12-in thick ASTM A 533-B class 1 and 2 steels. E.C.

N70-20803# Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
THE CHEMICAL AND PHYSICAL ASPECTS OF LIQUID METAL EMBRITTLEMENT Final Report, May 1966-Jun. 1969
Carolyn M. Preece and Albert R. C. Westwood Aug. 1969 54 p refs
(Contract DA-18-001-AMC-1109(X))
(AD-697820; RIAS-TR-69-4C) Avail: CFSTI CSCL 11/6

A study was made of the influence of various liquid metals and solutions on the fracture behavior of aluminum, cadmium, silver, brass and silver-gold alloys. The principal experimental variables were composition and grain size of the solid, composition of the liquid metal phase, temperature and rate of loading. The results indicate that, by using appropriate values of these variables, it is possible to control (either enhance or inhibit) embrittlement over fairly wide ranges. Author (TAB)

N70-20840# Tokyo Univ. (Japan). Inst. for Nuclear Study.
INVESTIGATION OF MAGNET STEELS FOR PROTON SYNCHROTRON
Masayoshi Masuda and Tadayoshi Doke Dec. 1968 21 p refs
(SJC-A-68-6) Avail: CFSTI

Results of an investigation of the properties of various types of steel for use in proton synchrotron magnets are presented. Magnetic and mechanical properties of rimmed steel, silicon killed steel, aluminum killed steel, phosphor additive rimmed steel, and oriented soft iron were studied. NSA

N70-20860*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROSPACE STRUCTURAL MATERIALS Conference Proceedings
Washington 1970 334 p refs Conf. held at Cleveland, 18–19 Nov. 1969
(NASA-SP-227) Avail: CFSTI CSCL 11F

Development aspects of aerospace structural materials are presented. Emphasis is placed on fracture prevention and life prediction for heat resistant alloys, refractory materials, transition metals, and composite materials. For individual titles, see N70-20861 through N70-20882.

N70-20863*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL FATIGUE OF HIGH-TEMPERATURE MATERIALS
David A. Spera *In its* Aerospace Structural Mater. 1970 p 43-57 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

This paper describes thermal-fatigue research conducted to develop a method for predicting the thermal-fatigue life of high-temperature components. The first test program consists of producing comparative thermal-fatigue data on a wide variety of nickel- and cobalt-base alloys. The thermal-fatigue resistance of each alloy is calculated from measured transient temperatures by means of a theory which considers both low-cycle fatigue and cyclic creep. In the second test program simulated cooled turbine blades are thermally cycled in a high-velocity burner facility while under tensile load to simulate centrifugal stress. The blade specimens were cast from IN-100 and B-1900 alloys and are tested in the coated and uncoated conditions. Thermal-fatigue data produced in this program are used to evaluate the life prediction method when the complexities of airfoil shape, internal cooling, stress concentration, mean stress, and coating are introduced. The third test program

utilizes a plasma-jet heat source and sheet specimens to produce thermal fatigue in a controlled atmosphere, including an oxygen-free environment. Author

N70-20864*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRESENT STATUS OF THE THEORETICAL CALCULATION OF DIFFUSION AND DIFFUSION-RELATED MECHANICAL PROPERTIES
H. H. Grimes *In its* Aerospace Structural Mater. 1970 p 59-69 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

Using the properties of steady-state creep and diffusion as examples, a discussion of the degree of success one can now attain in predicting behavior is presented. A comparison of the empirical and theoretical approach in the prediction of creep behavior is given to illustrate the value of the mechanistic approach. The dependencies of creep rate on temperature, stress, and diffusion are discussed. Solid-state diffusion is treated in greater detail based primarily on Lewis studies. The problems in determining the various parameters in the equation for the diffusion coefficient are discussed. The effect of strain on diffusion is treated briefly, and experimental techniques to evaluate these effects are described. Typical results of some of these experiments are shown. Finally, the use of interatomic potential energy functions in the calculation of the various energy and volume terms in the vacancy diffusion equation is discussed and results are shown for these computer methods applied to the computation of migration energies. Author

N70-20865*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NICKEL-BASE ALLOYS FOR AEROSPACE APPLICATIONS
John C. Freche *In its* Aerospace Structural Mater. 1970 p 71-89 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

By limiting the number of alloying constitutents and making tungsten the primary alloying constituent, a nickel-base alloy designated WAZ-20 was developed which has an incipient melting temperature of 2375 F, about 150 F higher than conventional highly alloyed cast nickel-base alloys. Its tensile strength at 2200 F is 20 000 psi. Substantial increases in intermediate-temperature tensile strength and generally increased ductility and stress-rupture life were obtained with the alloy in the directional polycrystalline form as compared to the random polycrystalline form. Prealloyed powder products of TAZ-8A and alloy 713C were made by inert-gas atomization and extruded into bar stock. Tensile strength of the powder products was substantially greater than that of their cast counterparts up to 1400 F. In the 1800 to 2000 F range, the powder products exhibited superplasticity. It was possible to take advantage of this superplastic behavior to deform the prealloyed powder products into any desired shape. Author

N70-20866*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMOMECHANICAL PROCESSING OF THE NICKEL-BASE ALLOY U-700
Charles P. Blankenship *In its* Aerospace Structural Mater. 1970 p 91-100 refs (See N70-20860-08-17)
Avail: CFSTI CSCL 11F

The potential of improving the strength of the nickel-base alloy U-700 by thermomechanical processing (TMP) was investigated. Strengthening by TMP consists of extensive strain hardening by mechanical deformation in conjunction with a precipitation hardening reaction. The U-700 alloy was cold worked either in the solution treated condition or after the gamma and carbide precipitation steps in the conventional heat-treating schedule for this alloy. Cold working was accomplished by hydrostatic extrusion at reductions in area of 20, 35, and 50 percent. Aging after cold working followed the conventional heat-treating schedule. At temperatures of 1000 to 1200 F, the yield strength of the alloy after TMP was as much as 100 ksi greater than the yield strength after conventional heat treatment. TMP also improved the 1200 F stress-rupture life. At a stress of 120 ksi, the rupture life of the TMP samples exceeded 1500 hours. Conventionally heat-treated samples lasted about 400 hours in a similar test. The best combination of tensile and stress-rupture properties was obtained with 20 percent cold work in the TMP schedules. Author

N70-20867*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENTS IN DISPERSION-STRENGTHENED MATERIALS
Max Quatinetz and John W. Weeton *In its* Aerospace Structural Mater. 1970 p 101-118 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

Dispersion-strengthened products, comparable in strength to the best commercial products were produced by thermomechanical processing of comminuted and blended composites: Ni-4 ThO2 and Ni-0.5 Zr-4 ThO2 composites were prepared. The products were cold pressed, sintered, hot rolled, and subjected to 7, 14, or 21 cold-roll - anneal cycles. A number of the sheet materials produced were stronger in 2000 F tensile and stress-rupture properties than a processed reference powder and the best available dispersion-strengthened commercial nickel sheet product. While the strength of the dispersion products generally increased as the number of cold-roll - anneal cycles increased, changes in composition and processing were shown to affect the response of the materials to the working process. The mechanical comminution approach is applicable to complex alloys and could yield composite materials which combine the advantages of alloy properties with dispersion strength. Author

N70-20869*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT DEVELOPMENTS IN CHROMIUM AND CHROMIUM ALLOYS
William D. Klopp *In its* Aerospace Structural Mater. 1970 p 135-161 refs (See N70-20860 08-17)
(NASA-TM-X-1867) Avail: CFSTI CSCL 11F

Recent developments in chromium pertinent to its potential use in advanced jet engines are reviewed. Although chromium has a strength-to-density advantage over nickel, its inherent brittleness and further embrittlement by nitrogen during high-temperature exposure are serious limitations to its use. Twelve chromium alloys are currently under development, the strongest showing a potential 150°F (83K) service temperature advantage over nickel-base superalloys. However, a better balance between solution strengthening and precipitate strengthening must be achieved in order to improve the low temperature ductility of these alloys. Improved coatings for protection against nitrogen embrittlement must be developed. Author

N70-20870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CARBIDE STRENGTHENING OF TUNGSTEN AND MOLYBDENUM ALLOYS
Robert W. Hall, Peter L. Raffo, Walter R. Witzke, and William D. Klopp *In its* Aerospace Structural Mater. 1970 p 163-172 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

Arc-melted tungsten alloys strengthened by a finely dispersed hafnium carbide precipitate have exhibited outstanding high-temperature strength. The addition of 4 atom percent rhenium to such alloys significantly improves their low-temperature ductility. The alloy which exhibited optimum properties has the composition (in atom percent) W-4Re-0.35Hf-0.35C. In the swaged condition, this alloy combines a tensile strength of approximately 70 000 psi at 3500 F with a ductile-brittle transition temperature near 200 F. An exploratory study of similar molybdenum-base alloys strengthened by the hafnium carbide precipitate has been conducted.

The mechanical properties of these alloys were highly dependent on the thermomechanical processing schedule used for their fabrication. In the optimum processed condition, the experimental Mo-Hf-C alloys appear to have substantially better high-temperature strength than currently available commercial molybdenum alloys. Author

N70-20871*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MASS SPECTROMETRIC STUDIES OF THE VAPORIZATION OF REFRACTORY CARBIDES AND NITRIDES
Fred J. Kohl and Carl A. Stearns *In its* Aerospace Structural Mater. 1970 p 173-185 refs (See N70-20860 08-17)
Avail: CFSTI CSLC 11F

The use of many refractory materials is limited by their vaporization rates rather than by their melting points. Thus, to realize the full potential of the refractory transition metal compounds for high-temperature applications, the vaporization behavior of these materials must be known and understood. The Knudsen effusion method has been used in conjunction with a double-focusing mass spectrometer to study the high-temperature vaporization of some refractory carbides and nitrides. The carbide systems of titanium, vanadium, chromium, and yttrium and the nitride system of titanium have been examined. The previously unobserved molecular species TiC4, VC4, CrC2, YC4, and TiN have been identified. The dissociation energies of the molecular species have been determined along with other pertinent thermochemical quantities. These properties are of critical importance in testing theories of chemical binding and stability. The experimental results are discussed in terms of their fundamental chemical significance and practical implications. Author

N70-20872*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METAL-MATRIX FIBER COMPOSITES FOR HIGH TEMPERATURES
Robert A. Signorelli and John W. Weeton *In its* Aerospace Structural Mater. 1970 p 187-205 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

A program was designed to control matrix-fiber reaction during fabrication and elevated-temperature testing of composites by a combination of the following steps: The matrix alloy composition was selected to reduce the potential for diffusion recrystallization of the fiber, a solid-state sintering fabrication process was developed that used relatively low-temperature consolidation to reduce diffusion, and the fiber diameter was chosen to maximize the retained strength in the unreacted fiber core. Tungsten alloy fiber - superalloy matrix composites fabricated using the approaches evolved in this program demonstrated stress-rupture strengths for rupture in 1000 hours at 2000 F of 37 000 psi. This strength is six times that of conventional nickel superalloys and represents a potential for an increase of 200 F in turbojet engine turbine blade use-temperature. Preliminary oxidation and impact test studies also indicate that the material has merit for potential use as turbine blades. Author

N70-20877*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HOT-SALT STRESS-CORROSION OF TITANIUM ALLOYS
Hugh R. Gray *In its* Aerospace Structural Mater. 1970 p 251-268 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

A survey of engine manufacturers indicated that many titanium components in jet engines are operating at temperature and stress conditions where laboratory stress-corrosion tests indicate potential cracking problems. Field surveys conducted at engine overhaul depots to quantitatively measure salt concentrations on compressor airfoils demonstrated that salt deposits were accumulated during flight in excess of the minimum amounts reported to cause cracking in laboratory tests. Hot-salt stress-corrosion tests conducted in a dynamic air facility which simulated the environmental conditions in a compressor have demonstrated that high velocity airflow does not eliminate hot-salt stress-corrosion. Specimen surface preparation was found to exhibit a dramatic influence on susceptibility to hot-salt stress-corrosion. Mechanical tests and chemical analyses aimed at revealing the fundamental mechanism of hot-salt stress-corrosion have confirmed that hydrogen is generated during the corrosion process and causes embrittlement. Author

N70-20878*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME TENSILE AND ELECTRICAL RESISTANCE PROPERTIES OF PALLADIUM-HYDROGEN AND TITANIUM-HYDROGEN SYSTEMS
Robert J. Smith and Dumas A. Otterson *In its* Aerospace Structural Mater. 1970 p 269-278 (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

The variation in electrical resistivity with hydrogen-palladium ratio is related to the crystallographic structure and to the mode by which the hydrogen electron is added to the s- and d-bands of the palladium. The conclusions reached allow the prediction of the tensile properties. The alpha-phase, which is characterized by an unfilled d-band, has a high cohesive energy, while the beta-phase, for which the d-band is filled, has a low cohesive energy. The tensile properties in the region where both phases exist obey a simple mixture rule. Like palladium, titanium is a transition metal having unfilled s- and d-bands. The mechanical behavior of the titanium-hydrogen system should, therefore, also be examined from this point of view. Initial work in preparation of titanium-hydrogen compositions in wire form by electrolytic deposition of hydrogen has served to emphasize the tendency for hydrogen segregation and also the need for property data for the compositions high in hydrogen. Author

N70-20879*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF ENVIRONMENT ON EROSION-CORROSION PROCESSES
Hubert B. Probst *In its* Aerospace Structural Mater. 1970 p 279-293 ref (See N70-20860 08-17)
Avail: CFSTI CSCL 11F

The present corrosion problem associated with the use of super-alloys in aircraft gas turbine engines is described. The evolution of this problem is also considered. The problem is more serious today than in the years past: The higher strengths of today's alloys allow higher operating temperatures; however, the corrosion resistance of such alloys has not kept pace with their strength capabilities. Examples of specific effects of such environmental variables as thermal cycling, gas velocity, and gas composition on corrosion resistance are presented. Thermal cycling, particularly the frequency of cycling, has a strong influence on corrosion resistance. The effect of high gas velocity may be a combination of erosion and accelerated vaporization of protective scales. Author

N70-20881*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROTECTIVE COATINGS FOR SUPERALLOYS
Salvatore J. Grisaffe *In its* Aerospace Structural Mater. 1970 p 305-316 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11C

In order to achieve protection at temperatures beyond those possible with aluminide coatings, alternate coating concepts are under investigation. One such approach combines the excellent oxidation resistance (up to 2200 F) of low-strength heater alloys with the high-strength of oxidation prone superalloys. Cyclic laboratory furnace tests have shown that such systems offer considerable potential. For example, a Fe-Cr-Al-Y cladding on the cobalt alloy

WI-52 showed a net weight loss after 380 hours at 2000 F as compared with 30 hours for a commercial aluminide coating. This is an improvement of more than a factor of 12. Further evaluation of such promising systems is planned using the Mach 1 burner rig. Author

N70-20904# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FEATURES OF FATIGUE DIAGRAMS UNDER FRETTING-CORROSION CONDITIONS
V. N. Stepanov 18 Mar. 1969 8 p refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Materialov (USSR), v. 3, no. 3, 1967 p 282-285

The peculiarities of a fatigue diagram under fretting-corrosion conditions are examined; a method of the accelerated construction of the diagram is proposed, based on the known criteria of cyclic strength and also on the results on an investigation made for the cyclic strength of steels OKhN3M, St. 10, 65G and other material. Author (TAB)

N70-20922# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Final Report
M. Castagna, B. Chinaglia, A. Ferro, G. Montalenti, D. Monti et al Oct. 1968 202 p refs
(Contract EURATOM-074-65-10-TEEI)
(EURAEC-2087; EUR-4008; M-567) Avail: CFSTI

Investigations of iron and iron alloys are reported concerning the effects of strain rate on yielding and plastic flow of interstitial-free specimens with small Ti additions. These results are compared with those obtained in tests of similar specimens exposed to fast neutron irradiation. Other work is summarized on the effects of fast neutron irradiation on Fe-6.5 Si alloys with magnetorestriction and on 50% recovery from embrittlement in iron and steel. Experiments designed to establish neutron dosimetry for use in correlations with results of iron and steel irradiations are described. Dosimetry data on Ni-base iron alloys are correlated with magnetic properties of these alloys. Data are also included on mechanical properties of quenched and tempered steels. NSA

N70-20930# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF THE STRUCTURE OF SINTERED ALUMINUM POWDER MATERIALS
I. N. Fridlyander et al 15 May 1969 14 p refs Transl. into ENGLISH from the publ. "Nauchnyy Sovet Kompleksnoy Probleme 'Kibernetika' Voprosy Bioniki" Moscow, Akad. Nauk USSR, 1967 p 198-207
(AD-687609; FTD-HT-23-1338-68) Avail: CFSTI CSCL 11/6

An investigation of powder properties, of the properties of SAP pressed rods, of the region of Bragg (coherent) scattering and of microdistortions in powder particles as functions of the grinding (milling) time is presented. Particle size prior to nodulizing affects the size of the region of coherent (Bragg) scattering, this latter approximately equal to the particle size, with the level of microdistortions defined by the nodulizing process and the superheating of the powder during grinding. For cold- and hot-pressed briquets it was found that the dimensions of the r.c.s. and the level of microdistortions remain unchanged, while some decrease in the level of microdistortions was found to occur during hot pressing and cold rolling. Cold deformation of SAP is accompanied by breaking up of the substructure and an increase in lattice distortions. Heating of cold-deformed SAP specimens to 600 degrees C for three hours obliterates differences in degrees of deformation and is accompanied by consolidation of the r.c.s. Author (TAB)

N70-20943# Kernforschungszentrum, Karlsruhe (West Germany).
THE CORROSION PHENOMENON OF INTERNAL OXIDATION INDUCED BY LIQUID SODIUM WITH A VERY SMALL SODIUM OXIDE CONTENT
H. U. Borgstedt and G. Frees Dec. 1968 18 p refs Transl. into ENGLISH from the German Report No KFK-879 Sponsored by USAEC/EURATOM Exchange Program
(EURFNR-614; KFK-879) Avail: CFSTI

Metal phase embrittlement, caused by oxygen penetration, was observed when titanium-containing vanadium alloys were corroded by liquid sodium with oxide contents below 10 ppM in the 500 to 600 C temperature region. It was shown that the thermodynamic conditions for internal oxidation of vanadium-titanium alloys exist in the flowing sodium under test conditions. Oxygen penetration into the alloys obeys the laws related to the appearance of internal oxidation. Pointers for alloy development can be derived from the results. Author (NSA)

N70-20975# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
INVESTIGATION OF SPECIAL MELTS OF THE ALLOY INCOLOY 800 [UNTERSUCHUNG VON SONDERSCHMELZEN DER LEGIERUNG INCOLOY 800]
K. Ehrlich, K.-H. Kramer, and W. Schneider Jun. 1969 22 p refs In GERMAN
(KFK-987) Avail: CFSTI

The effect of alloying elements on the mixed crystal or precipitation hardening was investigated in three alloy compositions. The first was the normal Incoloy 800; 3.1 wt.% W was added to the second, and 3 wt.% Mo, 3 wt.% W, and 2.7 wt.% Nb to the third. The results show that only an insignificant mixed crystal hardening was caused by the addition of W or W, Mo, and Nb. Precipitation hardening occurs in the precipitation of quenched samples. In the alloy with 2.9 wt.% W, the Fe2W phase occurs, which causes only a slight hardening through the incoherent phase. The hardening maxima were obtained after precipitation for 130 to 1000 hr. Both the special alloys investigated were unsuitable for cladding materials. NSA

N70-20988# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICS AND CHEMISTRY OF PROCESSING OF MATERIAL
V. I. Danilovskaya et al 2 Jun. 1969 46 p refs Transl. into ENGLISH from the RUSSIAN report, no. 2, 1968 p 12-18, 79-86
(AD-693282; FTD-MT-24-111-69) Avail: CFSTI CSCL 11/6

Two reports are presented. One examines the problem about determination of temperature fields and dynamic temperature stresses in plates under the action of a flux of radiative energy of constant intensity and in a half-space (or in a rod) under the action of a flux whose intensity varies periodically in time. The other study deals with the effect of alloying Mo, W, and Ta with various amounts of Re on the mechanical properties of the resulting alloys, and particularly on the lowering of the critical temperature which determines the transition between the viscous or malleable state and the brittle state. Author (TAB)

N70-21013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT MATERIALS RESEARCH (SELECTED CHAPTERS)
B. K. Vulf et al Dec. 1968 141 p refs Transl. into ENGLISH from the book "Aviatsionnoe Materialovedenie" Moscow, Izd. Mashinostr., 1967 90 p
(AD-686309; FTD-HT-23-832-68) Avail: CFSTI CSCL 11/6

Contents: Heat resistant and oxidation resistant steels and alloys; Alloys based on refractory metals; Aluminum and its alloys; Magnesium and its alloys; Titanium and its alloys; Copper and its alloys; Beryllium; Influence of radiation on the structure and properties of materials. TAB

N70-21016 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF OXIDE PARTICLES ON PROPERTIES OF SINTERED NICKEL
V. M. Sergeenkova et al 22 Oct. 1969 6 p refs Transl. into ENGLISH from Poroshkovaya Met. Akad. Nauk Ukr. SSR (Kiev), no. 6, Jun. 1969 p 81-86 In ENGLISH and RUSSIAN
(NLL-Trans-746-318-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

The heat resistance of nickel strengthened by silicon, aluminum, zirconium, and hafnium oxides was investigated to determine the dispersion hardened characteristics at high temperatures. It is concluded that the mechanical properties of dispersion-strenthened nickel depend primarily on oxide concentration and particle size. The rupture strength is shown to increase with: (1) increasing amount of oxide, and (2) decreasing oxide particle size. F.O.S.

N70-21058# Naval Ordnance Lab., White Oak, Md.
THE TEMPERATURE DEPENDENCE OF SHOCK WAVE PROPAGATION IN BRASS AND ALUMINUM
Nathaniel L. Coleburn and Jerry W. Forbes 22 Aug. 1969 34 p refs
(AD-697931; NOLTR-69-150) Avail: CFSTI CSCL 20/12

Measurements at initial temperatures ranging from 20C to 450C reveal an anomalous effect of pre-heating on shock wave propagation in brass. The shock wave velocity observed at 20C is decreased about 20% at 450C for equal incident pressures. The anomaly is attributed to a disorder-order rearrangement occurring in Cu-Zn alloys of near stoichiometric composition. Pre-heated aluminum was observed to behave normally under dynamic compression. Relations were derived for computing the variation of the Gruneisen parameter with volume using the slope and intercept of the shock velocity - particle velocity curve and the initial temperature of compression. Author (TAB)

N70-21060# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICS AND CHEMISTRY OF PROCESSING OF MATERIALS: SELECTED ARTICLES
N. N. Rykalin et al 9 May 1969 54 p refs Transl. into ENGLISH from Fiz. i Khimiya Brabotki Materialov (USSR), no. 2, 1967 p 3-17, 74-79, and 87-93
(AD-696501; FTD-MT-24-69-69) Avail: CFSTI CSCL 11/6

Contents: Plasma processes in metallurgy and the treatment of materials; The effect of mechanothermal treatment on cyclical strength of welded samples of titanium alloy VT15; The mechanism of the formation of hot cracks with welding of niobium alloys. TAB

N70-21066# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
COMPATIBILITY INVESTIGATIONS WITH SIMULATED FISSION PRODUCTS ON STAINLESS STEEL AND MOLYBDENUM, WITH AND WITHOUT THE PRESENCE OF UO2 [VERTRAEGLICHKEITSUNTERSUCHUNGEN MIT SIMULIERTEN SPALTPRODUKTEN AN NICHTROSTENDEM STAHL UND MOLYBDAEN, MIT UND OHNE GEGENART VON UO2]
P. Hofmann, F. Thuemmler, and H. Wedemeyer May 1969 88 p refs In GERMAN; ENGLISH summary
(KFK-979; EUR-3967.d) Avail: CFSTI

Annealing conditions under which simulated metallic fission products affect the compatibility of UO2 with stainless steel and molybdenum were investigated. Powder mixtures of UO2 were used with Mo, stainless steel V2A corresponding to Type 321 SS, V4A corresponding to Type 316L SS and incorporating simulated fission products such as Cs2CO3, SrO, CeO2, ZrO2, Mo, Pd. Similar studies were conducted on stainless steel in respect of alkali compounds and alkaline earth compounds in the absence of UO2. When cesium carbonate was present in the powder mixtures vigorous reactions between this compound and stainless steel took place at 750 C and cesium chromates were formed. Strontium and cesium uranates were the principal products formed at 750 C. A reaction took place between CeO2 and chromium and between CeO2 and UO2 with mixed crystals being formed by CeO2 and UO2. Author (NSA)

N70-21073# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
PRECIPITATION BEHAVIOR IN NICKEL-VANADIUM ALLOYS [AUSSCHEIDUNGSVERHALTEN VON NICKEL-VANADINLEGIERUNGEN]
Karl-Heinz Kramer Feb. 1969 82 p refs In GERMAN
(KFK-935) Avail: AEC Depository Libraries

The investigation of the precipitation behavior of Ni-V alloys with 15.4 and 16.5 wt.% V showed that only the tetragonal theta equilibrium phase was precipitated. It was a matter of an ordered phase of structure type TiAl3, which was coherent at the beginning of the precipitation with the matrix. The orientation relation between matrix and precipitation determined by electron microscopic diffraction pictures showed that both lattices lie parallel. With longer precipitation a deformation occurred and the precipitated particles were arranged in rows. They consisted of (101) habitus planes. The formation of this boundary surface between matrix and precipitation was dependent on the boundary surface and deformation energy and on the chemical binding energies. In the modification of the particle form, a transition from coherent to semi-coherent boundary surfaces was found. Author (NSA)

N70-21075# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ULTRASOUND TREATMENT OF METALS
V. P. Severdenko et al 13 Aug. 1969 167 p refs Transl. into ENGLISH from the Russian
(AD-697617; FTD-MT-24-439-68) Avail: CFSTI CSCL 11/6

The basic problems connected with propagation of elastic vibration in various media are reviewed in popular form. The design of various emitters; the applications of ultrasonic vibration for dispersion, emulsification, coagulation and rectification of liquids, scrubbing of gases and use in metallurgy and metal-working industry are described. Author (TAB)

N70-21077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF ALLOYING AND HEAT TREATMENT ON THE STRENGTH AND CAVITATION RESISTANCE OF ALLOYS WITH AGE-HARDENABLE MARTENSITE
L. S. Malinov et al 17 Mar. 1969 14 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), v. 13, no. 5, 1967 p 29-32
(AD-697603; FTD-HT-23-1147-68) Avail: CFSTI CSCL 11/6

In an attempt to find a cavitation-resistant material for hydraulic turbines, tests were made of several low-carbon maraging steels, N20, N20M2, N20K15, N20TYu, N20M3TYu and N20K10M5TYu, containing 0.03 percent carbon, 19.7-19.85 percent nickel, 0-14.75 percent cobalt, and 0-4.85 percent molybdenum. After annealing and quenching, all the steels except N20K10M5TYu has a martensite content of 80-90 percent. Water-quenched N20K10M5TYu steel contained 45 percent martensite and after refrigeration in liquid nitrogen, 67 percent. However, after aging at 400-500C this steel had the highest hardness, owing to the combined effect of cobalt, molybdenum, titanium and aluminum. N20K10M5TYu steel also had the highest cavitation resistance. In another series of experiments, several precipitation-hardenable steels, such as OKh12N4TYu, OOKh14N8M2TYu, OOKh16N4MD2, and 1Kh17N5TYu were tested. These steels, after annealing and quenching, contained 80-95 percent martensite. Aging at 450-600C

raised the steel hardness to 400--500 HB. In the annealed and aged condition the steels had a cavitation resistance comparable to that of maraging steels. Author (TAB)

N70-21103*# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
RESEARCH ON MECHANISMS OF ALLOY STRENGTHENING. PART 1: STRENGTHENING THROUGH FINE PARTICLE DISPERSION. PART 2: CONTROL OF STRUCTURE AND PROPERTIES BY MEANS OF RAPID QUENCHING OF LIQUID METALS (SPLAT COOLING)
Semiannual Report
Nichlas J. Grant, Harish Dalal, Manohar Grewal, Christina Jansen, Donald Kenton et al. Jan. 1970 50 p
(Grant NGL-22-009-003)
(NASA-CR-109089) Avail: CFSTI CSCL 11F

Developmental work in the two-part program on mechanisms of alloy strengthening is discussed with emphasis on: (1) Cr2O3 contamination effect on stainless OD alloy stability; Ni-BeO alloys produced by internal oxidation; Ni-Mo-Co-Al-Al2O3 surface oxidation processing; copper-Beryllia and copper-alumina alloys produced by internal oxidation of fine powders; substructure refinement and electron microscopy studies of Fe-BeO alloys; and titanium carbide dispersion strengthened nickel base alloys; and (2) splat cooling of aluminum alloys; and increased terminal supersaturation in Al-Cu, Al-Fe, and Al-Si by splat cooling. E.C.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-19773*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
METAL-TO-CERAMIC SEALS FOR THERMIONIC CONVERTERS: A LITERATURE SURVEY
W. M. Phillips. 1 Nov. 1969 33 p refs
(Contract NAS7-100)
(NASA-CR-108231; JPL-TR-32-1420) Avail: CFSTI CSCL 11A

The available unclassified literature in the field of metal-to-ceramic seals has been reviewed for the applicability of various sealing techniques to nuclear thermionics. Evolution of current techniques is presented, with some comments on possible techniques that could be explored further should alternate seal fabrication methods be required. Data on corrosion resistance of braze alloys in cesium and irradiation damage to ceramics is also presented. The techniques currently applied to thermionic diodes is also briefly outlined. Author

N70-19789 Pennsylvania Univ., Philadelphia.
THERMAL EXPANSION OF COEFFICIENTS OF COMPOSITE MATERIALS
B. Walter Rosen (Ph.D. Thesis) 1968 138 p
Avail: Univ. Microfilms; HC $6.60/Microfilm $3.00 Order No. 69-5661

The present work is directed toward the definition of the effective thermal expansion coefficients of composites. The approach used is to develop appropriate thermoelastic energy functions and variational principles to define bounds on such functions. When the energy functions are expressed in terms of macroscopic state variables and effective thermoelastic properties, the energy bounds can be used to bound the effective thermal expansion coefficients. For an isotropic composite formed from two isotropic phases, an exact result for the single effective thermal expansion coefficient is obtained, when the composite bulk modules is known. When the bulk modulus is unknown, the result for the expansion coefficient is a pair of best possible bounds. A similar exact result is obtained for the volumetric expansion coefficient of an orthotropic composite of two isotropic phases. These results are expressed in terms of the composite effective elastic moduli and the volume averages of the phase thermoelastic properties. Dissert. Abstr.

N70-19800 Rensselaer Polytechnic Inst., Troy, N.Y.
MASS TRANSPORT IN CALCIUM SILICATES
Michael Schwartz (Ph.D. Thesis) 1968 208 p
Avail: Univ. Microfilms; HC $9.45/Microfilm $3.00 Order No. 69-6476

Calcium metasilicate occurring naturally and as a homogeneous glass was studied since the two systems have the same stoichiometry but exist in two dissimilar forms structurally. The crystalline material undergoes a transformation at 1125 C. The two systems were compared in terms of their transport properties and their structure. The electrical resistivity of the glass and the two crystalline forms was measured in the temperature interval from 220 C to 700 C. There were noticeable shifts in the infrared spectra of the glasses as a function of CaO content. These shifts were attributed to the changing bond character of the Si-O bond due to the presence of the alkaline earth cations. The appearance of three broad absorption bands in silicate glasses of widely different compositions suggest that the spectra are due to the short range order rather than the presence of any large structural groupings. Dissert. Abstr.

N70-19801# Boeing Co., Renton, Wash. Commercial Airplane Div.
ACOUSTIC PROPERTIES OF MATERIALS FOR USE IN TURBOFAN ENGINE LININGS
Robert H. Walton. 17 Jan. 1970 128 p refs
(D6-22748TN) Avail: CFSTI

Potential sound attenuating materials for use as acoustic linings in turbofan engines were surveyed. These included glass fiber cloth laminates, felted and woven metallic liners, Teflon and similar materials. The data taken includes acoustic flow resistance, the acoustic absorption coefficient and the acoustic impedance of samples up to 10 cm diameter. Some impedance measurements were also made with a high sound intensity tube. The above tests are a screening process to determine whether candidate materials should be further evaluated. Author

N70-19811 Pennsylvania Univ., Philadelphia.
DIELECTRIC AND INTERNAL FRICTION RELAXATION PROCESSES IN ALPHA-QUARTZ, SODIUM SILICATE AND BOROSILICATE GLASSES, AND IN REDUCED RUTILE (Ti-O(2-x))
William Warren Scott, Jr. (Ph.D. Thesis) 1968 233 p
Avail: Univ. Microfilms; HC $10.60/Microfilm $3.05 Order No. 69-5663

Dielectric measurements near room temperature on alpha-quartz have established that the previously observed dielectric relaxation process whose maximum occurs at about 250–300 C is in fact composed of two superimposed Debye relaxations. The relaxation processes in vitreous silica, Na2O-SiO2 glasses from 12–18 mole % Na2O, and two borosilicate glasses have been investigated between 4 and 400 K using internal friction and dielectric measurements. A new, low temperature relaxation has been found in all glasses. Internal friction studies of rutile at low temperatures have been made to determine whether previously

observed electron hopping at complex defect centers would also occur on the application of a mechanical field. Conclusive evidence is given for the mechanical relaxation of these electrons at two of the three previously proposed defects. Dissert. Abstr.

N70-19838# Oak Ridge National Lab., Tenn. Reactor Div.
VISCOELASTIC ANALYSIS OF GRAPHITE UNDER NEUTRON IRRADIATION AND TEMPERATURE DISTRIBUTION
Shih-Jung Chang, C. E. Pugh, and S. E. Moore Oct. 1969 33 p refs
(Contract W-7405-Eng-26)
(ORNL-TM-2407) Avail: CFSTI

The adaptation and application of linear viscoelasticity to the stress analysis of irradiated graphite under temperature gradients and dimensional changes are examined. Under the assumptions of uniform neutron distribution throughout the body and of a temperature-independent creep function, the generalized plane-strain viscoelastic solution for an arbitrary two-dimensional cross section is represented by the sum of four associated elastic solutions when multiplied by appropriate functions of the neutron dose. From this plane-strain formulation, solutions are obtained for various thick-walled circular cylinders which represent graphite core components in a Molten-Salt Breeder Reactor (MSBR) design study. These cylinders are subjected to radial temperature distributions and to a temperature-dependent neutron-induced dimensional change which has a quadratic dependence upon the accumulated neutron exposure. Author (NSA)

N70-19860*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
PLANETARY ENVIRONMENT SIMULATION: EROSION AND DUST COATING EFFECTS
G. L. Adlon, E. L. Rusert, and T. H. Allen Washington NASA 31 Oct. 1969 39 p refs
(Contract NAS1-8708)
(NASA-CR-66878; MDC-E0038-Vol-1) Avail: CFSTI CSCL 11C

Studied were effects of sand/dust erosion on candidate thermal control coatings, optical windows, and mirrors for the proposed 1973 Mars Viking Lander. Changes were determined in the following parameters as a result of exposure to the erosion environment: (1) coating thickness; (2) coating weight; (3) solar absorptance of coatings; (4) infrared emittance of coatings; (5) transmittance for optical windows; and (6) reflectance for optical mirrors. Martian sand/dust storm erosion conditions were simulated by airborne silica sand particles in wind at velocities of 220 ft/sec using air at a static pressure of 7 torr. Large increases in solar absorptance were measured for the majority of the coatings exposed to the simulated environment. The hard materials and the soft alumino-silicate pigmented glass resin coating experienced the greatest coating weight loss. Tests conducted to determine the extent of degradation of optical surfaces indicated that optical windows exposed for longer than 10 minutes and optical mirrors exposed for longer than 5 minutes were significantly degraded. Author

N70-19862# Electrotechnical Lab., Tokyo (Japan).
RESEARCHES ON THE EFFECTS OF WATER VAPOR ON THE ELECTRICAL PROPERTIES OF ELECTRICAL MATERIALS AND ON THE MEASUREMENT OF HUMIDITY
Kyoichi Kanou May 1969 76 p refs In JAPANESE; ENGLISH summary *Its* Res. No. 700
Avail: CFSTI

Research describing the dependence of water vapor adsorption on electrical properties of a variety of electrical materials, and the characteristics and design of various electric hygrometer elements developed on the basis of experiments is reported. The research included a general view on the adsorption phenomena of water vapor on electrical materials, control of atmospheric humidity, water vapor adsorption effects on electrical properties of specific materials, the variation of nylon 6 expansion treated with sulfuric acid with water vapor adsorption, and water vapor effects on the structure and electrical properties of antracene. Electric hygrometer elements for the measurement of low, middle, and high relative humidity regions, and the whole relative humidity region are described. Author

N70-19913# National Research Council of Canada, Ottawa (Ontario). National Aeronautical Establishment.
THE OXIDATION RESISTANCE OF ALUMINIDE-COATED 713C AND IN100 SUPERALLOYS
E. P. Whelan and R. V. Dainty Aug. 1969 84 p refs
(NRC-11023; MS-125) Avail: CFSTI

Four oxidation-resistant coatings and two sulfidation-resistant coatings were investigated. Coated specimens were alternately exposed to an oxidizing furnace atmosphere at 2000 F for two hours and then cooled to approximately 150 F for one-half hour. Specimen weight changes, and changes in specimen surface appearance, were recorded at regular intervals. Specimens were tested until either catastrophic failure occurred or 2000 hours had elapsed. The oxidation resistance afforded each alloy by each of the coatings was greater for 713C alloy than for IN100 alloy. In general the oxidation-resistant coatings provided adequate protection for 713C, while one sulfidation-resistant coating provided a more satisfactory protection than any of the others. The IN100 alloy was not protected adequately at 2000 F by any of the coatings. One sulfidation-resistant coating provided a limited degree of acceptable protection. Coatings on IN100 deteriorated by the formation of localized surface growths. Author

N70-19935# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A COMPREHENSIVE BIBLIOGRAPHY OF LITERATURE PUBLISHED BEFORE 1969 PERTAINING TO DIELECTRIC PROPERTIES OF Al_2O_3, BeO, HfO_2, MGO, SiO_2, AND ThO_2
S. C. Kenton, R. P. Schemmel, and J. L. Bates Oct. 1969 37 p refs
(Contract AT(45-1)-1830)
(BNWL-1180) Avail: CFSTI

A bibliography containing references to articles on the dielectric properties of Al_2O_3, BeO, HfO_2, MgO, SiO_2, and ThO_2 is presented. The references were selected by a search of Bibliography of High Temperature Chemistry and Physics of Materials, January 1960 through June 1968; Chemical Abstracts, 1907 through 1968; and Nuclear Science Abstracts, 1948 through 1968. NSA

N70-19936# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A COMPREHENSIVE BIBLIOGRAPHY OF LITERATURE PUBLISHED BEFORE 1969 PERTAINING TO ELECTRICAL CONDUCTION IN Al_2O_3, BeO, HfO_2, MgO, SiO_2 AND ThO_2
S. C. Keeton, R. R. Schemmel, and J. L. Bates Oct. 1969 57 p refs
(Contract AT(45-1)-1830)
(BNWL-1181) Avail: CFSTI

A bibliography is presented on the electric conductivity of ceramic materials which represent the most attractive candidates for high temperature electric insulation. The literature surveyed included Chemical Abstracts (1907 through 1968), Nuclear Science Abstracts (1948 through 1968), and the Bibliography of High Temperature Chemistry and Physics of Materials in the Condensed State (1960 through mid-1968). The references are arranged in sections under the following headings: alumina, beryllia, hafnia, magnesia, silica, thoria, and other selected metal oxide insulator and general articles. NSA

N70-19965*# TRW Systems Group, Redondo Beach, Calif.
INVESTIGATION OF RESIN SYSTEMS FOR IMPROVED ABLATIVE MATERIALS
E. A. Burns, H. R. Lubowitz, and J. F. Jones. 1 Oct. 1968. 157 p refs
(Contract NAS3-7949)
(NASA-CR-72460; TRW-05937-6019-R0-00) Avail: CFSTI CSCL 11D

Resin matrices required for improved ablative materials for use with high energy fluorine-containing liquid propellant systems were investigated. Two high char forming polymer systems were synthesized, fabricated, and evaluated in composite form for ablative use effectiveness. These aromatic/heterocyclic polymer systems were designed to be processed readily with the evolution of minimum quantity of volatile matter during cure. Low void, high strength composites were prepared which exhibited ablative performance (dimensional stability, weight retention, and resistance to thermal shock) superior to commercially available ablative materials when tested in a FLOX/methane torch combustion environment. Tested composites were prepared using Refrasil, graphite, and carbon cloth and titanium diboride fibrous reinforcements. Author

N70-20013# Army Foreign Science and Technology Center, Washington, D.C.
USE OF SODIUM ALUMOMETHYL SILICONATE FOR FABRIC FINISHING
R. Z. Dushkina. 14 Nov. 1969. 10 p. Transl. into ENGLISH from Tekstil'n. Prom. (USSR), no. 9, 1968. p 57-59
(AD-698085; FSTC-HT-23-142-70) Avail: CFSTI CSCL 11/5

A new silicone preparation, sodium alumomethyl siliconate (AMSR), was tested for the finishing of fabrics from various fibers for the purpose of giving them hydrophobic properties. Results of tests reveal that an AMSR preparation imparts hydrophobic properties to fabrics of different raw material composition (cotton, viscose and acetate fibers, dacron, wool) and in water-repelling properties is the equal of such well-known hydrophobic agents as chromolan and primenit VS. Author (TAB)

N70-20083*# Monsanto Research Corp., Dayton, Ohio.
DEVELOPMENT OF NONFLAMMABLE COATING FOR POLYCARBONATE Final Report
M. C. Willson and C. E. Semler. Mar. 1969. 88 p refs
(Contract NAS9-8357)
(NASA-CR-102197) Avail: CFSTI CSCL 11C

Sodium and potassium silicates were applied by drawing and dipping techniques to polycarbonate. A polyurethane coating between the silicate and the substrate was required to achieve good adhesion. Polymeric films, usually polyurethane or polystyrene, were applied over the silicate to improve the long-time stability of the coating system. A limited number of organic-modified silica coatings were prepared but were significantly less effective than the alkali-silicate coatings in preventing flame damage to polycarbonate. Experimental glass compositions were formulated for plasma spraying studies from the alkali-B2O3-SiO2, soda-lime-silica, and BaO-Al2O3-B2O3 systems. Commercial glasses were also employed. All plasma-sprayed coatings were too translucent to satisfy optical requirements in the intended application. Optically transparent pyrex coatings were applied to polycarbonate by RF sputtering, but substrate discoloration was observed in most cases. Author

N70-20199# Vermont Univ., Burlington.
THE FRACTURE ENERGY OF COMPOSITE MATERIALS Final Report, 31 Aug. - 7 Dec. 1968
John Outwater and Michael C. Murphy. 1 Nov. 1969. 29 p refs
(Contract DAAA21-67-C-0041)
(AD-698031) Avail: CFSTI

A new test method for the measurement of adhesion is described and demonstrated. This method measures the debonding fracture energy between epoxy resin and glass. The effect of moisture on such a joint is shown as are the influences of different glass finishes. Analysis of these data show that the decrease of fracture energy of a joint that results from moisture penetration is directly proportional to the quantity of water present at the joint interface. Author (TAB)

N70-20221# Naval Research Lab., Washington, D.C.
THE EFFECT OF SURFACE FINISHING ON STRUCTURAL-CERAMIC FAILURE Interim Report
Karl R. Mc Kinney and Charles M. Herbert. 5 Nov. 1969. 30 p refs
(AD-697923; NRL-6942) Avail: CFSTI CSCL 11/2

A relationship between fracture strength and surface finish of brittle nonmetallic materials was examined and related to surface crack theory. An experimental illustration used AlSiMag 614, a 94% pure alumina with a near zero porosity. Specimen disks 3.625 + 0.031 in. in diameter by 0.085 + 0.010 in. thick were prepared, each having a specific surface finish. Testing was done with a biaxial ball and ring test. Observations were made regarding other materials and other abrasive powders. Author (TAB)

N70-20236# European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center.
PREPARATION AND CHARACTERIZATION OF DENSE NiO-BASE CERAMICS (NICKEL OXIDE AND LITHIUM SUBSTITUTED NICKEL OXIDE)
C. Geel, R. Moriotti, and S. Pizzini. 1969. 16 p refs
(EUR-4390e) Avail: CFSTI

Preparation and quality control methods for nickel oxide base ceramics are described. It is shown that for pure nickel oxide the physico-chemical properties, as density and excess oxygen content, are strongly influenced by the manufacturing process, mainly by the preliminary treatment of the powder. In the case of strong lithium doping it is observed that the achievement of the highest lithium concentrations (as dissolved lithium) requires longer annealing periods, of the order of 3 – 4 days. Author

N70-20506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICAL TREATMENT OF THE SURFACE OF A GLASS FIBER: SELECTED ARTICLES
Z. I. Bronshtein et al. 8 Jul. 1969. 12 p refs. Transl. into ENGLISH from Khim. Obrab. Poverkh. Steklyannogo Volokna (Moscow), 1966. 9 p
(AD-695936; FTD-MT-24-58-69) Avail: CFSTI CSCL 11/4

The influence of the method and extent of the desizing process on the properties of glass cloth treated with coupling agents and on the properties of glass reinforced plastics made thereof were investigated. Dicyandiamide-HCHO resin, gelatin or poly(vinyl alcohol), were used as the binding agents. The residual size content depends on the temperature of the thermal treatment and not on the size composition. Experiments were also conducted to determine the possibility of continuous and bath thermochemical treatments of glass fiber. A flow sheet is given for an experimental application for finishing glass fiber. The characteristics of an untreated fiber made of aluminoborosilicate non-alkali glass with an oiling agent (paraffin emulsion) are given. The finishing agent used for the chemical treatment of glass fiber are given. Author (TAB)

N70-20619# American Optical Co., Southbridge, Mass.
GLASS PREPARATION IN SPACE
Emil W. Deeg *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing. 5 Feb. 1970. p 41-58 refs (See N70-20617 08-30)
Avail: CFSTI

Low gravity, ease of access to high energy radiation and

to high vacuum are conditions making an earth orbiting laboratory unique for developing new glass making processes. Among them are crucible free melting, preparation of glasses sensitive to thermal convection, formation of lenses and mirror blanks with fire polished surface directly from the melt, formation of dispersion filters, ruby glasses and glass-ceramics requiring nucleation control through solid powder dispersion. Advantages of these methods and difficulties to be expected in performing the first experiments will be discussed. Author

N70-20621# Grumman Aerospace Corp., Bethpage, N.Y.
BORON FILAMENT MANUFACTURE IN SPACE: A LITERATURE FEASIBILITY STUDY
David Kloepper and Robert Witt *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 79-114 refs (See N70-20517 08-30)
Avail: CFSTI

A possible space manufacturing process for boron filament is described. Several central substrate deposition techniques, using different core materials, electric decomposition, and other boron-containing raw materials, are discussed. Nonsubstrate deposition techniques, such as glow discharge on a rotating disc or between two pointed tungsten electrodes, are described. Several techniques to manufacture boron filament from the melt are discussed. This survey points out a way to manufacture boron filament in space that involves heating high-purity boron to 2800 F in boron nitride crucibles, and then transferring it into an RF-positioning field for further heating by induction coils or hot gas. Author

N70-20622# General Electric Co., Philadelphia, Pa.
WEIGHTLESS, CONTAINERLESS MELTING AND SOLIDIFICATION OF POTENTIAL NEW METAL AND CERAMIC PRODUCTS
R. T. Frost *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 115-134 (See N70-20517 08-30)
Avail: CFSTI

A number of suggestions have been made for the weightless processing in space of metals and ceramics. Processes which can be considered are the casting of superalloy materials containing rare earth oxide inclusions and the casting of metal emulsions where convection currently leads to phase segregation. Under containerless processing we can consider extensions and scale up of processes which have been studied in terrestrial levitation experiments. Possible applications are the preparation of ultrapure materials and solidification under conditions of extreme subcooling. Ultrapure refractory materials which are easily contaminated by molds are logical candidates. Preparation of high density glasses and ceramics by containerless solidification can also be considered. Author

N70-20624# North American Rockwell Corp., Downey, Calif.
POSSIBILITIES FOR PRODUCING NEW GLASSES IN SPACE
R. A. Happe *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 146-175 refs (See N70-20517 08-20)
Avail: CFSTI

Zero gravity melting permits the elimination of a solid container during both the melting and cooling phases of glass production. The combination of superheating well above the melting temperature and cooling in the absence of most normal nucleation sites promises to permit the production of glasses from normally crystalline materials such as Al2O3, HfO2, ZrO2, etc. Such glasses should find immediate applications in refractive optics, where the unusual combinations of index of refraction and dispersion can be used to advantage in highly corrected multi-element lenses. The possibilities for returning supercooled liquids as glasses from orbit and growing single crystals on earth is discussed. Heating equipment and atmospheres for space melting of glasses are considered. Author

N70-20603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALL UNION CONGRESS ON CHEMISTRY AND THE APPLICATION OF ADDITIVES TO LUBRICANTS AND FUELS (SELECTED ARTICLES)
S. E. Krein et al 9 Jun. 1969 71 p refs Transl. into ENGLISH from Proc. of Conf. Presented in USSR, 1966 p 148-157, 281-324, 336-341, 370-388
(AD-694430; FTD-HT-23-1496-68) Avail: CFSTI CSCL 11/8

Contents: Corrosion-inhibitor additives and preservative running oils based on them; Operating experience with ZIL-130 engines using AS-8 oil with VNII NP-360 additive; Effectiveness of using additives in hydraulic-coupling oils for passenger automobiles; Selection of optimum additive combinations for motor oils on a bench with a single-cylinder air-cooled engine; In-storage property changes of oils of various classes and determination of their purity; and Use of paired antioxidants for turbine oils. TAB

N70-20621# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
DEVELOPMENT OF A LABORATORY TECHNIQUE FOR DEFINING MECHANICAL SHEAR STABILITIES OF MULTI-GRADE ENGINE OILS Final Report
Maurice E. Le Pera and Jules Pigliacamoi Nov. 1969 16 p refs
(AD-698027; CCL-273) Avail: CFSTI CSCL 11/8

A program was initiated to define the mechanical shear stability of polymer-thickened lubricating oils in terms of a laboratory bench-scale technique. In subsequent evaluation studies using standard laboratory-type paint blending/mixing devices, a kinetic dispersion mill was found to induce shear degradation of polymer thickeners in multi-grade engine oils. Further refinement of this technique led to the establishing of a satisfactory correlation with single and multicylinder engine tests. Author (TAB)

N70-20625*# General Electric Co., Philadelphia, Pa.
TESTING OF DIELECTRIC MATERIALS AND APPLICATION TECHNIQUES IN ELECTRONIC PACKAGING Final Report
22 Dec. 1969 128 p ref
(Contract NAS8-21333)
(NASA-CR-102454; DOC-69SD-4371) Avail: CFSTI CSCL 11G

The results of a test program in extended temperature ranges of mechanical, physical and electrical properties for ten dielectric materials between -125 C and +125 C are given. In addition, the adequacies of these materials in the extended temperature range in specialized applications in vacuum, ultraviolet, and vibration environments are reported. Author

N70-20632*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF HEAT STERILIZATION AND VACUUM EXPOSURE ON SOME LOW-DENSITY HEAT-SHIELD MATERIALS
George F. Sykes, Jr. Washington Mar. 1970 23 p refs
(NASA-TN-D-5696; L-6436) Avail: CFSTI CSCL 11D

The effects of dry heat sterilization for 92 hours at 135 C in flowing nitrogen and 200 hours of exposure at 66 C to pressures in the 0.00001-N/sq m range upon the thermochemical properties of five blown-foamed and five molded composite heat-shield materials are determined. Differential thermal analysis was employed to follow the changes which occur in each material as a result of sterilization and vacuum exposure. The results show that, on the whole, the composite materials have greater sterilization mass losses than the foamed materials and that the high-vacuum losses of both types of material are approximately equal. During high-vacuum exposure, the mass loss was approximately 1 percent after 200 hours of exposure, and at 200 hours the rate of mass loss ranged between 0.00025 and 0.00111 percent per hour for most of the materials. Author

N70-20642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADDITIVES TO LUBRICANTS
A. M. Kuliev et al 31 Jan. 1969 16 p refs Transl. into ENGLISH from the RUSSIAN
(AD-694771; FTD-HT-23-848-68) Avail: CFSTI CSCL 11/8

Contents: The selection of an antioxidant component for a detergent additive; and The problem of determining the dutergent properties of oils. TAB

N70-20713*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANTI-STATIC FILM LAMINATE Patent Appl.
Jack Naimer, inventor (to NASA) Filed 4 Dec. 1969 11 p
(NASA-Case-MSC-12255-1; US-Patent-Appl-SN-881968) Avail: CFSTI CSCL 11I

A high strength antistatic plastic film laminate is described for inhibiting the buildup of electrostatic charges on plastic bodies. The discharging structure constitutes an extremely fine metal filament grid which is interposed between two layers of plastic. The fine metal filament grid and plastic layers are fused by the application of heat and pressure, thereby filling the interstices of the grid with the plastic material. NASA

N70-20799# Army Weapons Command, Rock Island, Ill. Science and Technology Lab.
SYNTHESIS OF AROMATIC OR ALIPHATIC POLYSULFONE RUBBER Technical Report
L G. Wiedenmann Oct. 1969 17 p refs
(AD-698020; TR-70-118) Avail: CFSTI CSCL 11/10

Polypropylene sulfide and poly(ethylene sulfide-propylene sulfide), both containing unsaturation, were prepared and cured. The polypropylene sulfide-based vulcanizate, although poorer in original properties, was better in retention of properties after heat aging. Surface oxidized samples of poly(ethylene sulfide-propylene sulfide) showed very low oil and fuel swell but the oxidized material was water soluble. Satisfactory cures were not obtained using the polymers which contained no unsaturation. High polymers could not be obtained with diarylsulfones and blocks of dimethylsiloxanes or fluorocarbons. Author (TAB)

N70-20817# American Optical Co., Southbridge, Mass. Central Research Lab.
RESEARCH AND DEVELOPMENT OF HIGH QUALITY LASER GLASS Final Report, 1 Sep. 1967-31 May 1969
Richard F. Woodcock, Emil W. Deeg, and Carl G. Silverberg Nov. 1969 51 p refs
(Contract N00014-68-C-0192; ARPA Order 306)
(AD-697694; Rept-607-F) Avail: CFSTI CSCL 11/2

The use of Nd doped glass systems for high brightness or high intensity applications requires that the laser material must be free of inclusions, of good optical quality, free of Fe 2 and ion impurities which absorb strongly at 1.06 micromicron and in many cases must possess these properties over large volumes of glass. This report describes progress toward achieving this end. The all-ceramic melting facilities are described and operational problems are delineated. Model homogenization experiments were performed and results are presented. Evaluation of glass produced from the all-ceramic facilities was carried out and the data are tabulated. Author (TAB)

N70-20873*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-TEMPERATURE RESIN-MATRIX COMPOSITES
Tito T. Serafini *In its* Aerospace Structural Mater. 1970 p 207-215 ref (See N70-20860 08-17)
Avail: CFSTI CSCL 11D

Chemical modification and end-capping of polyimide prepolymers are two approaches that are employed to improve the processibility of polyimide polymers for application to components. An amide-modified prepolymer and an ester-modified prepolymer resisted imidization at temperatures to 284 and 250 F, F, respectively, compared to an unmodified prepolymer which imidized at 230 F. In addition to being more resistive to imidization, it was observed that these modified prepolymers also underwent chain extension without any loss of solubility. The hydrolytic stability of the ester-modified prepolymer was far superior to that of the amide-modified and unmodified prepolymers. The end-capping approach utilized uses reactive alicyclic rings that are placed on the ends of low-molecular-weight polyimide prepolymers. At elevated temperatures and pressures, the end caps coreact without the release of volatiles. This permits high-quality, void-free composites to be fabricated. Author

N70-20874*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND ANALYSIS OF FIBER COMPOSITE STRUCTURAL COMPONENTS
Christos C. Chamis *In its* Aerospace Structural Mater. 1970 p 217-228 (See N70-20860 08-17)
Avail: CFSTI CSCL 11D

Analysis, design, and optimization of structural components made from fiber composites require knowledge of many composite material properties as well as mathematical formalisms which relate the structural response of the component to appropriate properties of its constituents. Selection of the proper combination of constituent materials (fiber and matrix) fiber content, fiber directions, and component thickness to meet certain design requirements leads to the optimum design of the particular structural component. This paper briefly describes our current work in the areas of analysis, design, and optimization with metallic and nonmetallic fiber composites. An example to illustrate the genesis of the mathematical formalisms in relating metallic-composite strength to its constituent materials is described in some detail. The optimization problem of a composite engine blade is defined, and the residual stress in particular composite components is described. Author

N70-20882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIALS PROBLEMS IN AUTOMOTIVE EXHAUST REACTORS FOR POLLUTION CONTROL
Robert E. Oldrieve and Neal T. Saunders *In its* Aerospace Structural Mater. 1970 p 317-330 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 11D

Major contributors to air pollution from automobile engines include hydrocarbons (HC) and carbon monoxide (CO). Automobile exhaust reactors (afterburners) have shown good potential for reducing these pollutants by oxidizing the HC and CO to water vapor and carbon dioxide. From the oxidation process, the exhaust reactors reach temperatures from about 1600 to 1900 F under normal driving conditions. This high-temperature oxidizing environment in combination with other corrosive constitutents in the exhaust gas such as lead present a severe environment for reactor materials. Development of materials for use in automobile exhaust reactors considers both metallic and ceramic materials. The current status of the materials development planned as well as the status of other development work in this area are described. In addition, factors affecting materials selection for use in the reactors are reviewed. Author

N70-20988# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALL-UNION CONGRESS ON THE CHEMISTRY AND APPLICATION OF LUBRICANT AND FUEL ADDITIVES 1966. LUBRICANT ADDITIVES, TRANSACTIONS (SELECTED ARTICLES)
A. M. Ravikovich et al 4 Jun. 1969 58 p refs Transl. into ENGLISH from Izd-Vo Khimiya, (Moscow), 1966 p 60-67.

210-214, 219-228, 228-236
(AD-693269; FTD-MT-23-85-69) Avail: CFSTI CSCL 11/8

Contents: Lubricating oil antiwear additive obtained on the basis of aromatic extract of oils and phosphorus pentasulfide; Investigation of the solubilizing capacity of motor oil additives; Investigation of the mechanism of the effect of detergent motor oil additives; Reactions of organochlorophosphorus compounds with a metallic friction surface. TAB

N70-20997# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOSCOW. ALL-UNION SCIENTIFIC AND INVESTIGATIVE INSTITUTE ON PROCESSING OF PETROLEUM, TRANSACTIONS

Yu. S. Zaslavskii et al 19 Jun. 1969 66 p refs Transl. into ENGLISH from the Russian Report. no. 10, 1967 p 163-168, 237-256, 290-298, 322-328, 349-353
(AD-693464; FTD-MT-24-26-69) Avail: CFSTI CSCL 11/8

Contents: Radioindicator method of investigating the detergent and antioxidizing properties of motor oil additives; Some remarks on a method for studying the radiation stability of lubricants; A method of determinating the critical temperature of formation of a boundary layer oil firm; Method for investigating the radiation resistance of fluids for hydraulic systems; Evaluation of oil and solid lubricant stability in the zone of rolling friction; Laboratory method of investigating and evaluating the radiation resistance of lubricating greases. TAB

N70-21011# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT-RESISTANT INORGANIC COATINGS (SELECTED PORTIONS)

A. A. Appen 22 Jul. 1969 197 p refs Transl. into ENGLISH from the Russian report
(AD-697686; FTD-MT-24-497-68) Avail: CFSTI CSCL 11/3

The book discusses the composition, methods of application, and properties of various heat-resistant inorganic coatings for protection of constructional materials from corrosion and erosion at increased and high temperatures. The physical, chemical, and technological principles of the formation of inorganic coatings applied to solid metal surfaces and produced from melts are presented. TAB

N70-21086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURAL CHANGES IN SOME CERAMIC MATERIALS UNDER NEUTRON RADIATION

N. S. Kostyukov et al 26 Mar. 1969 7 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Sibirskoe Otdelenie, Ser. Khim, Nauk, no. 4, 1967 p 43-46
(AD-697605; FTD-HT-23-1239-68) Avail: CFSTI CSCL 11/2

Four commercial electroceramic materials, 22XC, M-7, MG-2, and Uralit, were irradiated with doses of neutron and gamma in a reactor channel and analyzed before and after irradiation by petrographic, X-ray diffraction, and IR spectroscopic measurements to define their irradiation resistance. The ceramics 22XC and M-7 consisted mainly of alpha-alumina with narrow glassy bands whose thickness did not exceed 2-3 microns. MG-2 and Uralit consisted of isometric crystals and prismatic crystals, mainly alpha lumina with narrow glassy bands. The study of irradiated specimens did not reveal any change in structure, phase composition or absorption except modifications caused by a slight widening of the glassy inclusions. The absence of essential changes indicated the high irradiation resistance of the studied ceramics. Author (TAB)

N70-21097 National Lending Library for Science and Technology, Boston Spa (England).

STUDY OF CERTAIN DIFFUSION PHENOMENA IN GLASS BY CONTACT MICRORADIOGRAPHY USING X-RAY FLUORESCENCE

G. Dusollier 28 Nov. 1969 10 p refs Transl. into ENGLISH from Verres et Refractaires (Paris) v. 22, no. 2, Mar.–Apr. 1968 p 163–169
(NLL-M-7862-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Micrographic techniques were adapted for the observation of metallic ion diffusion phenomena in glass. Studies were made of the diffusion of potassium in soda lime glass in contact with a potassium glass, diffusion of tin into a soda lime glass in contact with molten tin, and surface deposition phenomena with silver and copper on soda lime glasses previously in contact with molten tin. Results indicate that contact microradiography is a simple technique applicable to diffusion phenomena in glass. N.E.N.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-19761*# California Univ., La Jolla. Dept. of Applied Physics and Information Science.

FACTORIZATION OF SPECTRA BY DISCRETE FOURIER TRANSFORMS

Charles L. Rino 1969 10 p refs
(Grant NGL-05-009-079)
(NASA-CR-108253) Avail: CFSTI CSCL 12A

A discrete Fourier transform method for factoring arbitrary spectral density functions is presented. The factorization can be implemented in a straightforward and efficient manner, and it does not require that the spectra be rational. An expression for the absolute error is also presented. Author

N70-19766*# Texas A&M Univ., College Station. Inst. of Statistics.

SELECTION INDEX ESTIMATION FROM PARTIAL MULTIVARIATE NORMAL DATA

W. B. Smith and R. C. Pfaffenberger Sep. 1969 24 p refs
(Grants NGR-44-001-097; NIH 5-TIGM-1321-06)
(NASA-CR-108233; TR-1) Avail: CFSTI CSCL 12A

A technique is applied to the estimation of the selection index, when incomplete multivariate normal data records are available. The procedure utilizes all data available, both full and partial vectors, and represents an improvement in precision of the estimator over that found by using the full data vectors only. Estimates of phenotypic means and variance-covariance matrix also result from the procedure. Individuals with partial data records are indexed by an extension of the technique and this index is compared to that proposed by Henderson. The results of computer simulations are tabulated. Author

N70-19768 California Univ., Berkeley.

THE FRACTION OF GOOD PARITY-CHECK MATRICES AMONG THOSE HAVING GOOD PARTIAL WEIGHT DISTRIBUTIONS

Jack Howard Kurzweil (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-3641

A parity-check code is defined as the row space of the generator matrix. A codeword is any element of this row space including the all zero element. There are 2(k) codewords. In any codeword, the first k digits are known as the information digits and

the last (n-k) digits are known as the parity-check digits. An analytic expression is used to investigate the existence of codes whose minimum distance lies between the Gilbert and Elias Bounds.
Dissert. Abstr.

N70-19771 California Univ., Berkeley.
ON STOCHASTIC DIFFERENTIAL EQUATIONS ARISING IN STATE ESTIMATION PROBLEMS
Frank Paul Romeo, Jr. (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC 4.20/Microfilm $3.00 Order No. 69-3685

Two problems of importance concerning the estimation of state in dynamical systems are considered. First, a stochastic partial differential equation for the conditional density of the state given the observation is derived. Secondly, a new formulation of the state estimation problem is given. This formulation explicitly incorporates as a constraint the recursive form of the nonlinear filter. The resulting equations for finding the optimal filter are reasonably tractable and are investigated in a number of examples.
Dissert. Abstr.

N70-19821 California Univ., Berkeley.
GENERALIZATION OF THE BIG PICARD THEOREM
Myung He-Son Kwack (Ph.D. Thesis) 1968 48 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-3642

To generalize the big Picard theorem it is stated that a holomorphic mapping from the punctured disk into the Riemann Sphere minus three points can be extended to a holomorphic mapping from the whole disk. H. Huber extended this theorem.
Dissert. Abstr.

N70-19827# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
BARGMAN-WIGNER EQUATIONS ON THE INHOMOGENEOUS DE SITTER GROUP
V. I. Fushchich and L. P. Sokouor 1969 38 p refs In RUSSIAN
(ITF-69-33) Avail: CFSTI

The equations of the Bargman–Wigner type invariant under the inhomogeneous de Sitter group P(1,4) (the rotation and translation group in the five-dimensional plane Minkowski space) are constructed. A detailed group-theoretical analysis of these equations is carried out. The explicit form of the generators of the group P(1,4) is derived for the case when the basic invariants of this group P sq = W = V = 0. The question of the invariance of the Bargman–Wigner equations under the P-, T-, C-transformation is considered.
Author (NSA)

N70-19859*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
LIAPUNOV STABILITY CRITERIA FOR RANDOMLY SAMPLED SYSTEMS
Leonard Tobias Washington Feb. 1970 29 p refs
(NASA-TN-D-5683; C-99) Avail: CFSTI CSCL 12A

This study is concerned with the asymptotic behavior of systems in which random sampling occurs; they are studied by a stochastic Lyapunov function method. The control loops under consideration consist of a random sampler, a zero order hold, a linear plant, and a feedback element. Sampled systems are modelled randomly when sampler imperfections such as jitter or skipping occur or when a single computer or communications link is a component of multiple control loops. Improved stability criteria are given for systems whose inputs are identically zero for all time. When the feedback element is linear, sufficient conditions for asymptotic mean-square stability and asymptotic stability with probability one are obtained and compared. Necessary and sufficient conditions are also presented; these are used to analyze the value of the sufficient conditions. Intersample behavior is studied and results are presented for both stable and unstable plants. Numerical results illustrate the applicability and utility of the criteria presented and describe some interesting phenomena such as jitter stabilized systems. When random inputs are present, a general method is given for the computation of the asymptotic mean-square output at sample instants. This method is illustrated by a computer program for a general second-order system.
Author

N70-19915# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fizik.
STRICT LOCALITY, MICROCAUSALITY AND THEOREMS OF TYPE OF THE POMERANCHUK THEOREM
Yu. M. Lomsadze and E. P. Sabad 1969 43 p refs Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev
(ITF-69-46; CONF-690417-17) Avail: CFSTI

Strict locality and microcausality principles are formulated both for the asymptotical and the strict amplitudes without whatever appealing to the temperateness of growth of generalized functions. A close connection between these principles is established. It is shown that meeting of these principles, different from the Meyman locality and the strict localizability Jaffe principles, does not yet guarantee the theorems of the Pomeranchuk theorem type to be fulfilled. Additional conditions are found securing the validity of these theorems.
Author (NSA)

N70-19939# Argonne National Lab., Ill. Chemistry Div.
A NOTE ON ERROR ESTIMATION WHEN A CALIBRATION CURVE IS USED
Arthur H. Jaffy and Jerome L. Lerner Jul. 1969 24 p refs
(Contract W-7405-eng-38)
(ANL-7584) Avail: CFSTI

This note examines error estimation associated with a particular use of a calibration curve. The essential features appear in the case of a measuring device whose detection efficiency Y varies with time x. Measurements with several standard samples are used to construct a calibration curve of efficiency versus time, Y = f(x), and this curve is used to correct all measurements to a standard efficiency. The measured values for one of the standards are also so corrected, and the squared error in the average is estimated as a sum of squared deviations from the average, divided by nu, the number of degrees of freedom. With n denoting the number of data points with the specified standard, nu should be less than n, as in the usual least-squares analysis, because of the correlation introduced by use of the same quantities in estimating Y = f(x).
Author (NSA)

N70-19951# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FERMI-GUPTA AND SCHWINGER-BLEULER SUBSIDIARY CONDITIONS
I. V. Polubarinov 1969 38 p refs In RUSSIAN
(JINR-P2-4564) Avail: CFSTI

Subsidiary conditions in electrodynamics are analyzed in the interaction and Heisenberg pictures. The effect of the conditions on the elements of S-matrix is investigated, S-matrix being taken both between the infinite and finite times. The work of subsidiary conditions in the quantized Yang–Mills and Einstein theories is briefly considered. The peculiarity of the usual S-matrix due to nonabelian gauge group is discussed. It is stressed that transformed S-matrix, possessing invariance with respect to the additive gauge group, satisfies the physical condition of unitarity.
Author (NSA)

N70-20005 North Carolina Univ., Chapel Hill.
REMARKS ON FUNCTIONS SATISFYING A WEIGHTED AVERAGE PROPERTY
David Phillip Stanford (Ph.D. Thesis) 1968 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10205

The weighted average property is studied for functions from a region in an n-dimensional Euclidean apece E sub n to the real numbers. A method is given for constructing functions satisfying a weighted average property on a region in E sub alpha and beta from such functions on regions in E sub alpha and E sub beta. From this, results are obtained concerning the dimensionality of the space S(w,R) of functions satisfying the weighted average property with respect to a given weight function w on the region R. In particular, it is shown that S(w,R) may be infinite dimensional even if w is very poorly behaved. It is shown that under appropriate conditions on the weight function w, a function whose sections satisfy the weighted average property with respect to the sections of w will belong to S(w,R). Dissert. Abstr.

N70-20006 Virginia Univ., Charlottesville.
BOUNDED AND COMPACT VECTORIAL HANKEL OPERATORS
Lavon Barry Page (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-4030

A Hankel operator on H squared is an operator H such that S*H = HS. H squared and the simple shift are replaced by an arbitrary shift S acting on a separable complex Hilbert space. A bounded operator H on the Hilbert space is called a Hankel operator if S*H = HS. This algebraic definition agrees with the definition used in conjunction with the simple shift and is analogous to the algebraic definition of vectorial Toeplitz operators. Nehari's result is generalized to the present setting, and Hevoner's duality theorem is shown to carry over to the more general context. Representations in an appropriate function-apace model are given for the bounded and compact Hankel operators discussed. Most of the discussion, however, is carried out in a model-free setting. In particular a model-free factorization theorem for analytic operators is obtained which parallels a factorization theorem of Sarason. The factorization theorm is used in generalizing Nehari's result. Dissert. Abstr.

N70-20008 Pennsylvania State Univ., University Park.
THE STRUCTURE OF CERTAIN SEMIGROUPS WITH TWO IDEMPOTENTS
Phillip Eugene Mc Neil (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-9787

Certain compositions and extensions of finite nilpotent semigroups which are called "free" are considered. If X is any finite, nonempty set, F sub X is the free semigroup generated by X, m >1 is a positive integer and I sub m is the set of all words of F sub X which are products of m or more generators, then the Rees quotient is defined to be the free nilpotant semigroup with generators X and height m. Dissert. Abstr.

N70-20009 Texas A&M Univ., College Station.
SCANNING PROCEDURES FOR NONLINEAR MATHEMATICAL PROGRAMMING: LOW-DIMENSIONAL NON-CONVEX PROBLEMS
Sterling Wanson Mc Guire (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-8492

A convex programming algorithm for linear constraints is developed which essentially involves the solution of a sequence of subproblems of the original problem, each of which is formed by constructing the largest possible hypersphere inside the feasible region, i.e., every point of the hypersphere is a feasible point. The objective function is then maximized, restricted only by the hypersphere. By using the method, it is possible to generate a sequence of increasing values of the objective function. If the usual convexity conditions hold, the sequence of subproblem solutions converges to the maximum feasible value of the objective function. A scanning procedure is developed for the special case of separable programming with linear constraints. The method of scanning is based on criteria for excluding from investigation a portion of the scanning region. The new spherical programming algorithm is incorporated into the scanning procedure to generate an increasing sequence of relative optima. Finally, a scanning procedure similar to the first is developed for concave programming with unrestricted constraints. Dissert. Abstr.

N70-20010# Wisconsin Univ., Madison. Dept. of Computer Sciences.
THE NUMERICAL SOLUTION OF VOLTERRA FUNCTIONAL DIFFERENTIAL EQUATIONS BY EULER'S METHOD
Colin W. Cryer and Lucio Tavernini Sep. 1969 54 p refs
(Contracts DA-31-124-ARO(D)-462; N00014-67-A-0128-0004) (AD-697898; TR-71) Avail: CFSTI CSCL 12/1

Two methods are developed for numerically solving the Cauchy problem for Volterra functional equations; these methods are generalizations of the methods of Euler and Heun for ordinary differential equations. It is proved that these methods converge and a numerical example is given. Author (TAB)

N70-20018 Georgia Univ., Athens.
REPRESENTATIONS OF SOLVABLE LIE ALGEBRAS
Bruce Earl Reed (Ph.D. Thesis) 1968 19 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9514

Let L be a solvable Lie algebra over an algebraically closed field of characteristic zero. Suppose n is the dimension of L. In this paper that L has a faithful representation of degree not greater than n + 1 + n(n) is proven. Birkhoff proved that a nilpotent Lie algebra of dimension n and nilpotency class k has a faithful representation of degree not greater than 1 + n + n(2) + ... + n(k +1). A version of this result is obtained and is shown to be less than or equal to 1 + n(k). It is also proved that the nilpotency class of the associative algebra associated with the representation is k. Now let L be a Lie algebra with the property that L = L(1) + N where N is a nilpotent ideal. Then Birkhoff's representation of N can be extended to it, yielding a representation of L faithful on N. No restriction is put on the base field to obtain these results. Dissert. Abstr.

N70-20019 Wisconsin Univ., Madison.
ON THE ESTIMATION OF THE FOURIER COEFFICIENTS OF CUSP FORMS FOR HECKE GROUPS
Peter David Smith (Ph.D. Thesis) 1968 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-997

Estimates on the order of magnitude of the Fourier coefficients of cusp forms of dimension -r, r>0, defined on the Hecke groups are obtained. These groups consist of all matrices with determinant 1 where a,b,c,d are integers and the matrix is written on one line with a bar separating the upper row from the lower row. Rankin's method to the groups Hecke G($\sqrt{m}$) and their principal congruence subgroups and obtain results is extended for these groups. This method depends on the study of certain Dirichlet series and does not use Kloosterman sums. In addition Selberg's method of vector cusp forms is adapted to the Hecke groups. Dissert. Abstr.

N70-20023 Utah Univ., Salt Lake City.
HARMONIC ANALYSIS ON IDEMPOTENT SEMIGROUPS
Stephen Edmond Newman, Jr. (Ph.D. Thesis) 1968 79 p

Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-3852

Functions of bounded variation on idempotent semigroups, algebras on idempotent semigroups, and the relationships between them are studied. New light is shed on the relationship between functions of bounded variation and bounded, regular Borel measures. A commutative, idempotent semigroup S and a semigroup of semicharacters on S which contains the identity semicharacter are considered. A denotes the Boolean algebra of subsets of S generated by kernels of semicharacters. Dissert. Abstr.

N70-20024 Missouri Univ., Columbia.
THE INITIAL VALUE PROBLEM FOR NON-LINEAR EVOLUTION EQUATIONS
Russell Lee Koos (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-3392

Initial value problems for two nonlinear differential equations are considered. The solutions sought are not classical solutions, but solutions in an abstract sense. Six existence theorems are presented. Two of these existence theorems deal with the special case in which K(t,u) = f(t) is a u independent function from [a,b] into F. One of these theorems is a genralization of an existence theorem obtained by R. S. Phillips; the other is a partial generalization of an existence thuorem obtained by T. Kato. Four existence theorems are presented for the general case, one of which is a generalization of an existence theorem obtained by I. Segal. It is also shown that each of the solutions obtained is unique. Dissert. Abstr.

N70-20035 Case Western Reserve Univ., Cleveland, Ohio.
REDUCIBILITY ORDERING OF THE HYPERARITHMETIC SETS
George Clifford Nelson (Ph.D.Thesis) 1968 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-9429

The many-one degrees of the hyperarithmetic predicates which have the form H sub a (x) for a in O, where O is Kleene's set of constructive ordinal notations are studied. If gamma + or - O and gamma is not of the form alpha + 1 or alpha human indexe using rank correlation any alpha, then L(gamma) is universal is proved, i.e., any countable partially ordered set can be embedded in L(gamma). This is proved by constructing elements in O from certain recursively enumerable sets so that their properties are the same as those of their degrees of recursive Turing under Turing reducibility and then adapting directly a construction of Sacks. A question posed by Moschovakis is answered as to whether there exists a minimum element in L(gamma) if omega3 < or - gamma < omega 1 and gamma is a principle number for addition. A result of Shoenfield is generalized and a primitive recursive omega-rule is added to the system Z sub micron for arithmetic as an additional rule of inference. Dissert. Abstr.

N70-20039 Pennsylvania State Univ., University Park.
AUTOMORPHISMS OF FORMAL PUISEUX SERIES
William Albert Webb (Ph.D. Thesis) 1968 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-9618

Let P denote the ring of formal Puiseux series, that is, summations of the form a sub r times x to the rth power where r runs over an arithmetic progression of nonnegative rational numbers, and the a sub r are complex numbers. Let G denote the group of automorphisms of P. P has a topology under which it is a topological vector space, and a ring, but not a topological ring. This property illustrates one major difference between P and the ring of formal power series studied previously. It is proved that all endomorphisms of P, except the trivial one, are automorphisms of P, and all automorphisms of P are continuous. Also, there is a one to one correspondence between the automorphisms of the ring P and the automorphisms of the field of formal Puiseux series. It is also shown that all automorphisms of P are essentially given by composition with elements of P having zero constant term. Since the elements of G act as linear transformations on the vector space P, a useful representation of G by infinite matrices is available. Dissert. Abstr.

N70-20073 Iowa State Univ. of Science and Technology, Ames.
ANALYSIS OF COVARIANCE WHEN THE CONCOMITTANT VARIABLE IS MEASURED WITH ERROR
James Sullivan De Gracie (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-4226

Four cases of analysis of covariance were converted. The problem of obtaining an estimator for the slope of the model in the last case stated above is noted. A number of estimators are proposed and compared with respect to their biases and mean-square-errors. The biases are carried with their mean-square-errors. The estimator selected as preferred is then used in proposed estimation and testing procedures for treatment effects. The models to more than one concomitant variable are extended. In this case both bias and mean-square-error are carried. Dissert. Abstr.

N70-20074 Virginia Polytechnic Inst., Blacksburg.
THE EMPIRICAL BAYES APPROACH TO ANALYSIS OF VARIANCE AND LINEAR REGRESSION
Alvin Clarence Rencher (Ph.D. Thesis) 1968 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-4600

In repetitive experiments of a similar type, where the parameters vary randomly from experiment to experiment, the empirical Bayes approach often leads to estimators which have smaller single-tube-in-shell squared errors than the corresponding classical estimators. Tests of hypotheses were proposed for the random effects and fixed effects models in the analysis of variance. By Monte Carlo simulation, these were shown to be more powerful than the usual F-tests after at most three or four past experiences. Dissert. Abstr.

N70-20076 Louisiana State Univ., New Orleans. Agricultural and Mechanical College.
FINITELY GENERATED FLAT MODULES AND DETERMINANTAL RANK
Samuel Harry Cox, Jr. (Ph.D. Thesis) 1968 34 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-4458

The object of this paper is to determine sufficient conditions for a finitely generated flat R-module to be projective. All rings are commutative with identity. It is shown that a finitely generated R-module M is projective if and only if M is flat and there is an exact sequence $0 \rightarrow M \rightarrow F \rightarrow E$ with F and E projective R-modules. A corollary is that a finitely generated R-module M is projective if and only if M is flat, reflexive and $M^* = \mathrm{Hom}_R(M,R)$ is finitely presented. An example of a cyclic flat reflexive ideal M is given in a ring R such that M^* is cyclic but M is not projective. It is shown that a subring of a ring satisfying (FP) must satisfy (FP). If the Jacobson radical of a ring R contains a finite intersection of prime ideals then R satisfies (FP) is shown. Some questions which are still outstanding are listed. Dissert. Abstr.

N70-20077 California Univ., Berkeley.
ON MINIMAL MODELS OF COMPLEX VARIETIES
John Robert Zumbrunn (Ph.D. Thesis) 1968 20 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10415

It is postulated that a complex space X is hyperbolic if a certain pseudo-distance invariant under holomorphic mappings, is actually a distance. This generalizes the notion of hyperbolic Riemann surfaces in as much as they are ready examples of hyperbolic spaces. In this dissertation it is shown that projective

hyperbolic complex varieties are strongly minimal. The automorphism group of the field of rational functions of such a variety is isomorphic to the automorphism group of the variety. Similar results are obtained for varieties admitting a Stein covering or a Stein covering with ideal boundary. Relative minimality within the class of birationally equivalent non-singular projective varieties is demonstrated. Using the theory of exceptional varieties of the first kind, it is shown that projective manifolds with positive curvature are free from contractions along exceptional varieties of the first kind to projective varieties. Dissert. Abstr.

N70-20080 California Univ., Berkeley.
DIMENSIONAL PROPERTIES OF CERTAIN SPACES
Mohammad Ahmad Khan (Ph.D. Thesis) 1968 40 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-3635

Some dimensional properties of metrizable spaces are extended to certain classes of completely normal spaces. The behavior of dimension under extensions of topologies is studied. A topological space X is totally normal (strongly totally normal) if it is normal and if every open subspace U is union of a collection, locally finite in U, (star-finite) of open F sub sigma subspaces of X. X is weakly totally normal, if it is completely normal and if every open subspace is union of a point-finite collection of open, F sub sigma subspaces of X. Dissert. Abstr.

N70-20083 North Carolina Univ., Chapel Hill.
STATISTICAL TESTS OF THE EQUALITY OF CORRELATION MATRICES
Nancy Stooksberry Cole (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-10143

Tests of the multivariate hypothesis that K samples come from populations with equal correlation matrices are considered. While Fisher's z-transformation gives the standard bivariate statistic, no general multivariate statistics have been carefully examined. This is a study of several such statistics: two statistics published by Kullback, the likelihood ratio statistic, and two statistics based on the asymptotic multivariate distribution of the sample correlation matrix and of the corresponding z-transformations. Computerized Monte Carlo techniques give information on the distributions of the statistics under the null hypothesis for small samples and also provide empirical power comparisons among the statistics when using their asymptotic distributions. Dissert. Abstr.

N70-20090 Georgia Univ., Athens.
TAMING LOCALLY FLAT EMBEDDINGS IN HIGH DIMENSIONAL MANIFOLDS
Thomas Benny Rushing (Ph.D. Thesis) 1968 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9518

Previous results on taming are extended and the uses of such taming theorems are considered. An earlier result is generalized and it is shown that if there is a proper embedding of one combinatorial manifold into another which is PL on the boundary and locally flat on the interior, then it can be epsilon-tamed around the boundary in codimension three. Some unknotting theorems used in succeeding sections are proved. One of these is an unknotting of codimension three ball pairs theorem which generalizes an earlier result. It is shown that embeddings of certain nice polyhedra which are locally flat on open simplexes are tame in codimension three. Locally flat embeddings of certain combinatorial manifolds into a combinatorial manifold are shown to be homotopic to PL embeddings. Relationships are established between the so-called beta-statements and the annulus conjecture. Finally, taming theorems are employed to obtain a generalization of a result of Gluck which concerns the restriction of weak isotopies. Dissert. Abstr.

N70-20092 California Univ., Berkeley.
MINIMAL SURFACES WHOSE BOUNDARIES CONTAIN SPIKES
David Samuel Kinderlehrer (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-3637

A minimal surface in three-dimensional space which is the conformal image of the unit disc in the w plane slit along its non-negative real axis may be said to have a spike. This spike is the space curve which is the image of the slit. When the spike is an analytical curve, it is proved that the analytic functions whose real parts form the conformal representation of the surface have algebraic singularities at w = 0. The proof is an extension of an earlier proof of analytic extensibility for a minimal surface across an analytic boundary segment. The algebraic character permits an extension of the maximum principle for single valued solutions of the minimal surface equation in a domain of the (x,y) plane. Dissert. Abstr.

N70-20096# Joint Publications Research Service, Washington, D.C.
CYBERNETICS AND REGULATION THEORY
17 Dec. 1969 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 188, no. 3, 1969 7 p
(JPRS-49457) Avail: CFSTI

Collection processes for base commutators were investigated along with problems of finite control systems with distributed parameters. In the commutator study, the Shirshov process was examined with an aim of making the process faster by decreasing the number of commutators involved. The proposed methodology and supporting theorems are presented. In the finite control system investigation, a solution to the simplest problem of finite control for a wave controlled system is illustrated and applied to other types of hyperbolic and parabolic equations. The method has wide application to varied boundary condition and multidimensional equation problems. D.L.G.

N70-20104# Wisconsin Univ., Madison. Dept. of Computer Sciences.
TOPOLOGICAL PROBLEMS ARISING WHEN SOLVING BOUNDARY VALUE PROBLEMS FOR ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS BY THE METHOD OF FINITE DIFFERENCES
Colin W. Cryer Aug. 1969 69 p refs
(Contract N00014-67-A-0128-0004)
(AD-697897; TR-69) Avail: CFSTI CSCL 12/1

When the method of finite differences is used to approximately solve a boundary value problem for an elliptic partial differential equation over a two-dimensional domain R, the first step is to choose a set of netpoints, N. Next, a system of algebraic equations connecting the values of the approximate solutions at the netpoints is set up. Finally, the system of algebraic equations is solved. Usually, N is taken to be the set of points belonging to a rectangular grid, together with the points of intersection of gridlines with the boundary of R. When a computer is used, one or more of the following assumptions are often made in order to simplify the programming: (1) All the points of N are gridpoints. (2) The interior netpoints are gridconnected. (3) The number of irregular netpoints is much smaller than the number of regular netpoints. In the present paper these three assumptions are analyzed. Author (TAB)

N70-20115 Michigan Univ., Ann Arbor.
AUTOMATIC REGULATION USING LYAPUNOV'S FUNCTIONS
Edwin Ellis Speaker (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-2389

The asymptotic stability theorem of A. M. Lyapunov is applied to the problem of the synthesis of an optimal regulator system feedback control law. The systems considered are described

by ordinary differential equations and the performance criterion is the minimization of an integrated quadratic form. In summary, Lyapunov's asymptotic stability theorem presents a mathematical basis for a unified treatment of a class of optimal synthesis problems in the field of automatic control. The derivation of a series expression for a feedback control law results in system performance close to optimal performance when only a few terms in the series are used although the region of asymptotic stability of the series-controlled system may be finite and should be carefully examined in any application of the procedure. However, the series solution method has the advantage in that there is developed a control law expressed in terms of the system state. Dissert. Abstr.

N70-20122 Iowa Univ., Iowa City.
ASYMPTOTIC VALUE DISTRIBUTIONS FOR MATRIX GAMES
Donald Jay Soults (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-4282

This research is directed toward finding asymptotic value distributions for k x n zero-sum matrix games with independent and identically distributed payoff coefficients. Three payoff distributions are considered: uniform [0,1], inverse-uniform[1,∞], and normal. The principal contributions of this research are analysis of the relationship between a stochastic game and stochastic linear programming problems, asymptotic bounds and norming constants for the distribution of the value in the normal k x n case, asymptotic distribution of the value for a 2 x n game for the normal case and the asymptotic distribution for the inverse of the value in the inverse-uniform case. The relationship between passive stochastic linear programming and the game-value techniques utilized in this thesis are described. Dissert. Abstr.

N70-20127 Cornell Univ., Ithaca, N.Y.
ONE AGE DEPENDENT BRANCHING PROCESSES
Thomas Arthur Ryan (Ph.D. Thesis) 1968 68 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-7400

As a generalization of age-dependent branching processes, a branching process is defined, in which one particle (of age 0) has offspring throughout its lifetime. The number of offspring in dt depends on the number and times of birth of its previous offspring, and on t; and its time of death depends on the number and times of birth of its offspring. The offspring behave as the initial particle, independently of all other particles, and so on. Once the estimates are made, we can find the asymptotic behavior of the solution from the renewal theorem. Dissert. Abstr.

N70-20129 Case Western Reserve Univ., Cleveland, Ohio.
PLANAR DYNAMICAL SYSTEMS WITHOUT CRITICAL POINTS
Roger Clark McCann (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-9424

Planar dynamical systems without critical points were classified. To every such dynamical system pi there exists a family M of trajectories (called separatrices) whose closure is endowed with two relations and a topology. Dissert. Abstr.

N70-20136 Wisconsin Univ., Madison.
JORDAN ALGEBRAS WITH MINIMUM CONDITION
David Llewellyn Morgan (Ph.D. Thesis) 1968 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-14013

The structure of Jordan algebras satisfying the following two axioms is presented: (1) J has an identity element 1; (2) J has minimum condition on quadratic ideals. Dissert. Abstr.

N70-20140 Georgia Univ., Athens.
BOUNDARIES OF SEMILINEAR SPACES AND SEMIALGEBRAS
Roy Eugene Worth (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-9534

A semilinear space is considered to be a set S on which is given two operations, addition and scalar multiplication by non-negative real numbers only, such that S under addition is a commutative, cancellative semigroup with additive identity 0. Topological, metric, and complete metric semilinear spaces (called Banach semilinear spaces) are studied. Throughout, special attention is given to the boundary of a semilinear space, defined algebraically rather than topologically. Linear independence and basis for semilinear spaces are also defined. In semialgebras, concentration is placed on ideals. Dissert. Abstr.

N70-20157 Yale Univ., New Haven, Conn.
ON THE STRUCTURE OF BANACH ALGEBRAS
Mi-Soo Bae Smith (Ph.D. Thesis) 1968 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-8436

Relations between certain subgroups of the automorphism group of a C*-algebra are studied. For certain C*-algebra of type I, any automorphism which leaves every element of the center of the algebra elementwise fixed and extends to the von Neumann algebra is shown to be generated by this algebra with respect to a faithful *-representation zeta is zeta - inner. Next the important case of the C*-algebra, C(X; IB) where X is a compact Hausdorff space, and IB is the algebra of all bounded linear operators on a complex Hilbert space is studied. The notion of locally-inner automorphism of the C*-algebra C(X; IB) is introduced. If IB is the algebra of bounded operators on a finite dimensional Hilbert space, every centerfixing automorphism (of C(X; IB)) is locally-inner. If IB is the algebra of all bounded operators on an infinite dimensional Hilbert space then the quotient of the group of locally-inner automorphisms is identified by the group of inner automorphisms with the 2-nd Cech cohomology group of X with coefficients in the ring of integers Z. Consequently this group is always abelian. Dissert. Abstr.

N70-20160 Maryland Univ., College Park.
DUALS OF LOCALLY COMPACT GROUPS
Irwin Schochetman (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9583

The larger collection of central groups was studied. Consequently, a central group G is CCR and, there exists many finite dimensional elements in dual G to separate points in G. Because of these and other reasons, locally compact groups which are compact extensions of abelian groups are considered. There exist well-known (CA)-groups whose duals are not Hausdorff and do not contain enough finite dimensional elements. The (CA)-groups are extensions of regularly embedded subgroups ((ER)-groups). Dissert. Abstr.

N70-20161 California Univ., Berkeley.
ON SECOND-ORDER NECESSARY CONDITIONS FOR CONSTRAINED MINIMA
Edwin John Messerli (Ph.D. Thesis) 1968 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-10352

Two fundamental second order necessary conditions of optimality are developed for a canonical optimization problem. From these, most known second order necessary conditions for nonlinear programming problems are deduced, and often generalized. New second order necessary conditions are obtained for optimal control problems, one in particular, augmenting the Pontryagin Maximum Principle in special cases. The second order necessary conditions which are developed depend upon the use of fairly complex conical approximations to Omega about a solution point, and supplement

existing first order necessary conditions in certain situations of degeneracy. The derivation of the second order necessary conditions is carried out in a geometric framework consistent with the modern theory of first order necessary conditions, and makes crucial use of the Brouwer fixed point theorem. Dissert. Abstr.

N70-20163 Texas Univ., Austin.
EXISTENCE OF PRODUCT INTEGRALS
John Albert Chatfield (Ph.D. Thesis) 1968 51 p
Avail: Univ. Microfilms: HC $3.00/Microfish $3.00 Order No. 69-6126

Necessary and sufficient conditions are given on alpha sub G and beta sub G for the product integral of G to exist. Dissert. Abstr.

N70-20165 California Univ., Berkeley.
ACCRETIVE OPERATORS AND NON-LINEAR SEMIGROUPS
Joel Leonard Mermin (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-10351

The concern is with constructing, by means of certain operator limit formulas, the family of evolution operators associated with the abstract differential equation u'(t) = A(t)u(t), where for each t > or = 0, A(t) is a (nonlinear) accretive operator on a Banach space X having a uniformly convex dual space. Attention is paid to the special case where A(t) = A is independent of t, and the family of evolution operators associated with the above equation is a nonlinear semigroup having A as its infinitesimal generator. Dissert. Abstr.

N70-20172 Colorado State Univ., Fort Collins.
GRAPH CLASSIFICATION AND BASIS SET ANOMALIES
Lawrence Ellsworth Colip (Ph.D. Thesis) 1968 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-5471

In many problems of applied graph theory it is possible to consider either oriented or nonoriented graphs. This is especially true when the orientation associated with each edge is arbitrary. Certain anomalies have been shown to exist between matrices corresponding to sets of oriented subgraphs and matrices corresponding to sets of nonoriented subgraphs. A particular case of anomalous behavior is considered here and this behavior is found to be associated directly with specific classes of subgraphs. Thus the general structure of graphs and their classification is considered. The results suggest that it is desirable to consider sets of equations other than three based sets for the analysis of systems. By considering linearly independent sets based on more complicated subgraphs it is possible to obtain systems of equations which frequently are more amenable to accurate solution by a digital computer. Dissert. Abstr.

N70-20173 New Hampshire Univ., Durham.
THE EXTENSION OF A LOCALLY COMPACT LOCAL GROUP TO A GLOBAL GROUP
David Warren Cohen (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-4680

Proof that a locally compact local group is locally isomorphic to a global group is given; in fact, such a local group is locally the direct product of a compact group and a local Lie group. A similar structure theorem was obtained for locally compact global groups by V. M. Gluskov. The generalization of the global result to the local case is based upon the results and techniques of A. R. Jacoby. Dissert. Abstr.

N70-20189 Oregon Univ., Eugene.
IRREDUCIBILITY OVER COMPLETE RINGS
Ronald Paul Brown (Ph.D.Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-6618

A construction is given for certain polynomials over a commutative ring; in case the ring is a maximal field the monic irreducible polynomials are obtained exactly. For example the monic irreducible polynomials over the padic completion of the rational numbers are shown to naturally correspond to equivalence classes of certain maps. Using the construction necessary and sufficient conditions are given for irreducibility of polynomials over maximal fields. A slight generalization is given of Hensel's lemma for maximal fields. The irreducible polynomials of prime degree over a maximal field are presented very explicity. Finally certain known results about algebraic extensions of maximal fields are proved using the study of irreducible polynomials. Dissert. Abstr.

N70-20202# Technion - Israel Inst. of Tech., Haifa.
THE OPTIMAL CONTROL OF A QUEUEING PROCESS
M. Yadin and S. Zacks Jun. 1969 16 p refs Prepared in cooperation with New Mexico Univ. *Its* Mimemograph Series No. 54
(Contract F61052-68-C-0014; Grant NSF GP-9007)
(AD-696990) Avail: CFSTI CSCL 12/2

Controlled queueing processes have been studied by several authors. The common model is a one-station queueing system at which customers arrive at a steady rate. The important feature is that management can vary the capacity of the service station according to the queue size, and thus, by increasing or decreasing the service intensity, control the queue size. The present paper describes the problem of determining the optimal control policy. Intervals are considered of service intensity values (not discrete sets). The arrival of customers at the service station is assumed to be a homogeneous Poisson process with a known arrival intensity. The service time is assumed to be exponentially distributed, with an intensity which can be changed and controlled. The cost structure of the system is discussed. There are three main cost components. The orientation (or set-up) cost of changing the service intensity; the service cost; and the queueing cost. The policy of optimal control is derived with an infinite horizon, which minimizes the expected total discounted future costs. This is carried out by setting and solving the proper Dynamic Programming functional equations. TAB

N70-20214 South Carolina Univ., Columbia.
TORSION-FREE AND DIVISIBLE MODULES OVER MATRIX RINGS
David Rodd Stone (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-5814

Hattori's definitions of torsion-free and divisible modules over an arbitrary ring are studied and applied in particular to modules of matrices over rings of matrices, giving rise to the definitions of n-torsion-free and n-divisible modules. Pure and pure exact extensions of modules are also investigated, because of the inherent connection between this notion and torsion theory. It is proved that a short exact sequence is pure exact if and only if it is n-pure for all positive integers n, that a module is flat if and only if it is n-torsion-free for all n, and that a module is absolutely pure if and only if it is n-divisible for all n. Some basic results concerning rings and modules of matrices and pure extensions are derived, and the aforementioned purity result is proved. It is also shown that if the weak global dimension of a commutative ring is at most one, then the notions of pure and pure exact coincide. Dissert. Abstr.

N70-20227 Princeton Univ., N.J.
FIELD THEORETIC PROPERTIES OF NELSON'S MODEL
John Tucker Cannon (Ph.D. Thesis) 1968 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-2531

Quantum field theoretic properties associated with Nelson's Hamiltonian for the Yukawa-like coupling of nonrelativistic, spinless nucleons with a relativistic scalar meson field are studied. Li H sub

K denote Nelson's Hamiltonian in the case that a cut-off is introduced on the high momentum contributions to the perturbing part. The desired real-time vacuum expectation values are obtained in the sense of tempered distributions as boundary values. Basic properties of these boundary values are studied; in particular, they are limits in the sense of tempered distributions of the renormalized cut-off vacuum expectation values. However, Green's functions are not obtained. When the coupling constant is small the one-body problem for physical nucleons is solved. For this the Hamiltonian is reduced as a direct integral over the total momentum; Nelson's method is applied to the reduced Hamiltonian, and the eigenvalue problem is solved by the usual resolvent expansion. Dissert. Abstr.

N70-20281 Iowa State Univ. of Science and Technology, Ames.
METHOD OF IMAGES IN THE PLANE
Richard Walter Mensing (Ph.D. Thesis) 1968 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-4263

Planar versions of the invariance principle and the method of images have been applied to three problems in planar random walk. Asymptotic computations are simple for a particular one of a class of random walks, so that the invariance principle provides absorption results for tied and untied Wiener processes, as well as asymptotic results for the rest of the class in either problem. In problem (3) on the other hand, the process computations are simple so that the invariance principle provides asymptotic results for a certain class of random walks with drift. Dissert. Abstr.

N70-20304# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
PARAMETRIC DECOMPOSITION PROGRAMMING
Kanianthra Mani Chandy Oct. 1969 133 p refs
(Contracts Nonr-3963(06); DA-31-124-ARO(D)-209)
(AD-698155; TR-45) Avail: CFSTI CSCL 12/2

The report is concerned with the decomposition of block-diagonal linear and quadratic programming. We are primarily concerned with obtaining solutions as the right-hand side constraint vector and/or objective function is varied. A projection technique similar to Rosens is used. The decomposition of integer programming problems is also considered. Author (TAB)

N70-20306# Stanford Univ., Calif. Dept. of Operations Research
MULTIPLE CHANNEL QUEUES IN HEAVY TRAFFIC PART 4: LAW OF THE ITERATED LOGARITHM
Donald L. Iglehart Nov. 1969 29 p refs
(Contract N00014-67-A-0112-0031; Grant NSF GP-8790)
(AD-698180; TR-8) Avail: CFSTI CSCL 12/2

The queueing system considered consist of r. independent arrival channels and s independent service channels. These systems are assumed to be in heavy traffic, that is, the traffic intensity is greater than or equal to 1. Functional laws of the iterated logarithm are obtained for the queue length, departure, load, and waiting time processes. As immediate corollaries, the ordinary laws of the iterated logarithm are obtained for these processes. Finally, as an application of the functional law of the iterated logarithm, a limit theorem is obtained for the fraction of time the queue length process is above a given function. Author (TAB)

N70-20312 University of Southern Calif., Los Angeles.
ON THE THEORY OF SIGNAL FLOW GRAPHS
Milan Dusan Sedlar (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-5068

Presented is a generalized development of the theory of signal flow graphs, which considers the topological relationships of objects with multiple inputs and outputs. Systematic reduction procedures for generalized signal flow graphs, based on the system transmittance matrix, are derived. Systems in which both discrete and continuous variables are present are studied by means of a new extension of signal flow graph theory. A new flow graph element, termed a "black node" is introduced to facilitate the representation of the sampling process. An algebra for signal flow graphs containing both black and white nodes is developed and illustrated with numerous examples. The final chapter of the work is concerned with the application of signal flow graphs to sensitivity theory. In particular, the concept of a "sensitivity dipole" leads to minimum flow graph representations for the generation of sensitivity functions. Dissert. Abstr.

N70-20339# Arizona Univ., Tucson. Dept. of Physics.
TREATMENT OF PAIRING IN MANY-BODY SYSTEMS BY AN EQUATION-OF-MOTION METHOD Technical Report
R. H. Parmenter 21 Nov. 1969 38 p refs
(Contract N00014-67-A-0209-0007)
(AD-698149; TR-2) Avail: CFSTI CSCL 20/10

A completely unambiguous prescription is presented for extending the equation-of-motion method, including pairing, beyond the random-phase approximation. When combined with the idea of a generalized effective field, this prescription leads to a simple, self-consistent treatment of pairing, lifetime, and renormalization effects in many-body systems. Author (TAB)

N70-20381# RAND Corp., Santa Monica, Calif.
MEASURE THEORETIC STRUCTURES FOR SEQUENTIAL DECISION MODELS
Ralph E. Strauch Dec. 1969 24 p refs Presented at the 36th Natl. Meeting of the Operations Res. Soc. of Am., Miami Beach, Flor., 10-12 Nov. 1969
(AD-698145; P-4259) Avail: CFSTI CSCL 12/2

An expository paper is presented, concerning the elements which must be represented in probabilistic models of general state space sequential decision problems. These elements are described, and the ways they are represented in two such models, a dynamic programming model due to Blackwell and a gambling model due to Dubins and Savage, are examined. If the set of possible positions in which the decisionmaker might find himself is uncountable, then a measure theoretic structure connecting the basic elements of the problem is required in order to ensure adequate definitions of the overall dynamics of the problem and the value to the decisionmaker of his overall behavior. The dynamic programming model uses a countably additive measure structure based on metric considerations, while the gambling model uses finitely additive measures defined on all subsets of the basic space. Author (TAB)

N70-20385 Duke Univ., Durham, N.C.
THE PALEY-WIENER-SCHWARTZ THEOREM FOR FUNCTIONS ANALYTIC IN A HALF SPACE
Richard Dudley Carmichael (Ph.D. Thesis) 1968 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-3834

Separate necessary and sufficient conditions are obtained for both the Paley-Wiener and Paley-Wiener-Schwartz theorems to hold such that the function f(z) is analytic in either the upper, Im(z) greater than 0, or lower, Im(z) less than 0, half spaces. The easy direction of the half space is completed and a boundedness condition is obtained. Dissert. Abstr.

N70-20387# Naval Research Lab., Washington, D.C.
SOME LABELING THEOREMS FOR PLANAR LINEAR GRAPHS: A CONTRIBUTION TO THE FOUR-COLOR PROBLEM Final Report
Horace M. Trent, B. Lepson ed., and H. A. Hauptman ed. 22 Oct. 1969 52 p refs
(AD-697922; NRL-6902) Avail: CFSTI CSCL 12/1

According to Courant and Robbins, the four-color problem was probably proposed by Mobius in 1840. It was proposed again by De Morgan in 1850 and by Cayley in 1878. The problem may be stated as follows: Given any linear graph which will map on

a plane (or sphere), it is possible to assign one of four colors to each face of the map so that no two faces colored alike have a common edge on their boundaries. In 1879 Kempe published a proof of the conjecture. However, in 1890, Heawood showed that Kempes proof was defective, by use of a counterexample that disproved one of Kempes assertions. The portion of this manuscript from Comment 18 through Lemma 24 is designed to take care of the analog to Heswoods counterexample. In the same paper, Heawood showed that five colors were sufficient to color a planar map. The problem has received much attention in the intervening years. Although a number of interesting results have been obtained since 1890, no one has been able to exhibit a planar graph that required more than four colors, nor has anyone been able to prove that four colors were sufficient in all cases. The situation up to now is summed up rather well by Courant and Robbins. Despite the efforts of many famous mathematicians, the matter essentially rests with this more modest result: It has been proved that five colors suffice for all maps and it is conjectured that four will likewise suffice. This manuscript presents a new approach to and a partial proof of the conjecture. Author (TAB)

N70-20402# Applied Logic Corp., Princeton, N.J.
CRT-AIDED SEMI-AUTOMATED MATHEMATICS Final Report, 1 Jun. 1968-26 Aug. 1969
James H. Bennett, Francis C. Oglesby, James R. Guard, and Mark L. Bayern, Jr. Oct. 1969 29 p refs
(Contract F19628-69-C-0064)
(AD-697847; AFCRL-69-0464) Avail: CFSTI CSCL 12/1

The report describes the status of the sixth in a series of six experiments in semi-automated mathematics. These experiments culminated in large complex computer programs that allow a mathematician to prove mathematical theorems on a man-machine basis. SAM VI, the sixth program, uses a cathode ray tube as the principal interface between the mathematician and a high speed digital computer. An elaborate language and logical capability has been implemented in SAM VI. These include 1/10 languages for expressing mathematical statements in a form suitable for both the mathematician and the machine to recognize and handle with ease and convenience, a language for expressing and handling sorts and range of symbols, and auto-logic alogirthm and matching routine. The latter contain the capability for handling, automatically, logic with equality. Author (TAB)

N70-20403# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
ON A PERTURBATION THEORY USING LIE TRANSFORMS
Jacques Henrard Nov. 1969 25 p refs /*ts* Mathematical Note No. 630
(AD-698140; DI-82-0931) Avail: CFSTI CSCL 12/1

Kamel has recently extended to non-Hamiltonian equations a perturbation theory using Lie transforms. It is shown in this report extension can be approached from an intrinsic viewpoint, which reformulation leads to a simpler algorithm. Kamels contribution is then completed by establishing rules for inverting the transformation generated by the perturbation theory, and for composing two such transformations. Author (TAB)

N70-20405# RAND Corp., Santa Monica, Calif.
A DISASTER USING APPROXIMATIONS
Joel Spencer Nov. 1969 5 p
(AD-698183; P-4249) Avail: CFSTI CSCL 12/1

The author gives an example of the error resulting from truncating a series too soon. TAB

N70-20406# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
NUMERICALLY STABLE EXPLICIT INTEGRATION TECHNIQUES USING A LINEARIZED RUNGE KUTTA EXTENSION
R. H. Allen Oct. 1969 39 p refs
(AD-698139; DI-82-0929; Rept-39) Avail: CFSTI CSCL 12/1

Computer aided design requires repeated evaluation of the performance of a system model during development of the model and during parameter optimization. The analysis of a differential system model thus requires an efficient solution of a set of nonlinear ordinary differential equations, x dot = f(x,t), that model the system. Accurate system models contain short and long term effects; therefore such models have wide ranges of time constants (eigenvalues). Most numerical integration rules, including the Runge Kutta rules, require for numerical stability of the calculated response that the integration time step be limited by the smallest and possibly most uninteresting time constant. Some implicit integration rules, which require iteration, have no numerical instabilities regardless of the time step size. Presented in this paper is an investigation of a class of explicit integration rules, requiring no iteration, that possess numerical stability for any integration time step. Integration rules do not require limitation of the integration time step to provide numerical stability can reduce the number of integration steps significantly and thus greatly decrease the computer execution time necessary to calculate the response. Author (TAB)

N70-20413 Georgia Univ., Athens.
DYNAMICAL SYSTEMS
Robert Owen Morris (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9507

Dynamical systems are discussed including those in a metric space, on a torus, and on a cylinder. In dealing with metric space, the definition of a dynamical system is given and elementary results are developed. Limit sets of trajectories and Poisson stability are discussed. A theory is presented leading to and encompassing most known results of dynamical systems on a torus including those of Poincare and Denjoy. All results and examples are given outside the framework of differential equations. In discussing dynamical systems on a cylinder, the material presented has been motivated by well known results on trajectories in a plane. Dissert. Abstr.

N70-20424*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
COMPARISON OF PRIMAS AND RAYLEIGH-SCHRODINGER PERTURBATION THEORIES
D. M. Chipman and J. O. Hirschfelder 18 Aug. 1969 31 p refs
(Grant NGL-50-002-001)
(NASA-CR-108922; WIS-TCI-353) Avail: CFSTI CSCL 12A

The Primas and Rayleigh-Schroedinger formulations of perturbation theory are compared in extensive truncated analysis. The Primas approach appears useful only in special cases where the operators involved form a Lie algebra with a small number of elements. For Hamiltonians with degenerate energy levels or for many body systems, the Primas formalism does not appear practical. Author

N70-20425 Maryland Univ., College Park.
ERROR BOUNDS FOR DIFFERENCE APPROXIMATIONS TO INITIAL-BOUNDARY AND MIXED INITIAL-BOUNDARY VALUE PROBLEMS FOR PARABOLIC EQUATIONS OF GENERAL DOMAINS
George Deane Shank (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-9602

Initial-boundary value and mixed initial-boundary value problems for a second order uniformly parabolic operator defined on

a general domain are considered. Certain positive type difference approximations to these problems are defined. In particular for the problems in two space dimensions second order approximations to the normal derivative and to the second order uniformly parabolic operator are constructed. In N space dimensions a first order approximation to the normal derivative and a second order approximation to a class of second order uniformly parabolic operators are constructed. The behavior of the global error of these approximations as the mesh size tends to zero and its relationship to the smoothness of the solution which is being approximated are investigated. Two error estimates for the approximations to the initial-boundary value problem for the homogeneous heat equation are typical of the results. Dissert. Abstr.

N70-20430# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.
BAYESIAN STATISTICAL MODEL THEORY FOR MECHANICAL SYSTEMS
J. P. Walter 31 Aug. 1969 94 p refs
(Contract AT(04-3)-700)
(LMEC-69-8) Avail: CFSTI

The experiment sequencing problem is restated as an optimization problem, the object of which is to maximize information gained from experimentation; numerous candidates for an information gain function are introduced. Sequential Bayes estimation procedures are discussed for both parametric and empirical applications, where the methods of Hammond, Richardson, and Rutherford are presented. Examples include: (1) an instance of sequential Bayes point estimation on the basis of computer simulated Gaussian data, and (2) implementation of a technique for actual metallurgical experimental data, the errors of which are postulated to be Weibull-distributed. Author (NSA)

N70-20437*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
FORWARD AND BACKWARD CONTINUATION FOR NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATIONS
Jack K. Hale [1969] 24 p refs
(Grant NGL-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-67-0693A)
(NASA-CR-108913) Avail: CFSTI CSCL 12A

This paper considers the development in a class of equations which is more general than the ones considered by Hale and Cruz and has the advantage that it leads in a very natural manner to a discussion of the problem of the backward existence of solutions. After developing the basic theory of existence, uniqueness, continuous dependence and continuation of solutions, it is shown that solutions of most linear equations with bounded coefficients can not have a nonzero solution which approaches zero faster than an exponential. Author

N70-20554# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SIMULTANEOUS TESTS FOR EQUALITY OF LATENT ROOTS AGAINST CERTAIN ALTERNATIVES Final Report
P. R. Krishnaiah and V. B. Waiker Jul. 1969 37 p refs
(AD-697996; ARL-69-0119) Avail: CFSTI CSCL 12/1

The authors proposed procedures for testing for equality of latent roots of matrices against some restricted alternatives when the latent roots of the associated random matrices have certain distributions. The random matrices considered are (i) Wishart matrix (ii) (S sub 1) (S sub 2) superscript (-1) (iii) matrix connected with MANOVA and (iv) matrix associated with canonical correlations; here S sub 1 and S sub 2 are independently distributed central Wishart matrices. Author (TAB)

N70-20557# Aztec School of Languages, Inc., Acton, Mass.
CONTROL PROBLEM SOLVING WITH AN ANALOG COMPUTER
Josef Holan Jun. 1969 27 p refs Transl. into ENGLISH from Acta Polytech. (Stockholm), v. 3, no. 2, 1967 p 39-55
(Rept-(27)-69-525-CZLL) Avail: CFSTI

An analog model of controlled systems is described for computational methods for transient states. The physical quantities of one kind are modeled by quantities of another kind, usually by a voltage in the case of electronic analog computers. Analog simulation is based on a system of simultaneous differential equations describing a given device or on a block diagram with known or specified response of the individual blocks. A computer program is then designed from the analog model. R.B.

N70-20559# Michigan Univ., Ann Arbor. Systems Engineering Lab.
MATHEMATICAL MODELS OF INFORMATION SYSTEMS Final Technical Report, Oct. 1967-Oct. 1968
Harvey L. Garner Sep. 1969 143 p refs
(Contract AF 30(602)-3546)
(AD-694090; RADC-TR-69-256) Avail: CFSTI CSCL 9/2

This report summarizes research in the development of mathematical models of information processing systems. Particular attention is given to a new approach to automata theory, the use of multiple index matrices in generalized automata theory, asymptotic decomposition of machines, recognizability of equation sets, algebraic isomorphism invariants for transition graphs, iterative network realization of sequential machines, optimum sequencing of jobs subject to deadlines, and the theory of formal languages and its impact on the design and implementation of programming languages. Author (TAB)

N70-20630*# North Carolina State Univ., Raleigh.
OPTIMAL CONTROL PROBLEMS AS EQUIVALENT LAGRANGE PROBLEMS
Stephen K. Park Washington NASA Mar. 1970 15 p refs
(Grant NGL-34-002-032)
(NASA-CR-1550) Avail: CFSTI CSCL 12A

A method is described by which an optimal control problem with a compact, connected control region may be transformed into what is called a psi-equivalent Lagrange problem in the calculus of variations. The notion of psi-equivalence is explained and a condition sufficient to guarantee the psi-equivalence of two problems is stated. In particular, it is shown that an optimal control problem with a closed parallepiped control region can, after an appropriate transformation, always be treated as a Lagrange problem. Author

N70-20756# California Univ., Berkeley. Computer Center.
ON DIRECT METHODS FOR SOLVING SYMMETRIC SYSTEMS OF LINEAR EQUATIONS Technical Report
James Raymond Bunch May 1969 128 p refs
(Contract Nonr-3656(23))
(AD-697664; TR-33) Avail: CFSTI CSCL 12/1

There has been no stable direct method for solving symmetric systems of linear equations which takes advantage of the symmetry. If the system is also positive definite, then fast, stable direct methods (e.g., Cholesky and symmetric Gaussian elimination) exist which preserve the symmetry. These methods are unstable for symmetric indefinite systems. Such systems often occur in the calculation of eigenvectors. Gaussian elimination with partial or complete pivoting is currently recommended for solving symmetric indefinite systems, and here symmetry is lost. A generalization of symmetric Gaussian elimination is presented here, called the diagonal pivoting method, in which pivots of order two as well as one are allowed in the decomposition. It is shown that the diagonal pivoting method for symmetric indefinite matrices takes advantage of symmetry so that only 1/6 n cubed multiplications, at most 1/3 n cubed additions, and 1/2 n squared storage locations are required to solve A x = b, where A is a non-singular symmetric matrix of order n. Furthermore, it is shown that the method is nearly as stable as Gaussian elimination with complete pivoting, while requiring only half the number of operations and half the storage. Author (TAB)

N70-20764*# Stanford Univ., Calif.
PERTURBATION METHOD IN THE THEORY OF NONLINEAR OSCILLATIONS
Ahmed Aly Kamel Washington NASA Mar. 1970 refs
(Grant NGL-05-020-007)
(NASA-CR-1554; SUDAAR-389) Avail: CFSTI CSCL 12A

Perturbation expansions for treating nonlinear oscillation problems are presented. These expansions are based on a transformation similar to that of the Lie transforms described by Deprit. A combination of the obtained expansions and expansions based on Lie transforms is also suggested for those problems which are mainly represented by a Hamiltonian with some smaller perturbing forces nonderivable from a potential. Author

N70-20766 National Lending Library for Science and Technology, Boston Spa (England).
RINGS WITH THE MINIMUM CONDITION FOR QUASI IDEALS [KOLTSA S USLOVIEM MINIMALNOSTI DLYA PRISOED INENNYKH IDEALOV]
V. M. Kurochkin Nov. 1969 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 66, no. 4, 1949 p 549-551
(NLL-RTS-5418) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

A quasi-simple ring theorem is proved analogous to the Wedderburn-Noether theorem on simple rings. A quasi-right ideal is defined and mapped homorphically onto a ring, with a quasi-simple radical ring forming an operative group. J.A.M.

N70-20804# Colorado State Univ., Fort Collins.
OPTIMAL FRACTIONAL FACTORIAL PLANS FOR MAIN EFFECTS ORTHOGONAL TO TWO FACTOR INTERACTIONS, 2(m) SERIES
J. N. Srivastava and D. A. Anderson (Wyoming Univ.) Sep. 1969 29 p refs
(Contract F33615-67-C-1436)
(AD-697398; ARL-69-0146) Avail: CFSTI CSCL 12/1

A general theory of balanced 2 to the mth power fractional factorial designs are developed which permit estimation of main effects orthogonally to 2-factor interactions and the general mean, whose size N is desirably small, and which are optimal with respect to various standard criteria involving the variance-covariance matrix of the estimates. For various practical values of m and N, a method is given by which such optimal designs can be easily obtained from known balanced incomplete block designs. Author (TAB)

N70-20833# Colorado State Univ., Fort Collins.
ON THE COSTWISE OPTIMALITY OF HIERARCHICAL MULTIRESPONSE RANDOMIZED BLOCK DESIGNS UNDER THE TRACE CRITERION
J. N. Srivastava and L. L. Mc Donald Sep. 1969 22 p refs
(Contract F33615-67-C-1436)
(AD-697399; ARL-69-0147) Avail: CFSTI CSCL 12/1

Consider the class of general incomplete multiresponse (GIM) designs in which the set of units is divided into blocks of equal size, such that in any block the same subset of responses is measured on each unit. It is shown that with respect to the trace criterion and a reasonable cost restriction, the subclass of hierarchical multiresponse (HM) designs is complete in the sense that given any GIM design, there exists a HM design such that the cost involved under the two designs is the same, but the trace of the covariance matrix of the estimates of the parameters under the HM design is less than or equal to the similar quantity under the GIM design. The results also establish the important fact that there is a large class of situations where the standard multiresponse model (under which all responses are measured on each unit) should not be used. The nonlinear programming problem associated with obtaining the optimum HM design is stated and solved. Author (TAB)

N70-20902# Research Analysis Corp., McLean, Va.
AN ALGORITHM FOR SEPARABLE NONCONVEX PROGRAMMING PROBLEMS: NONLINEAR CONSTRAINTS
Richard M. Soland Nov. 1969 30 p refs
(Contract DA-44-188-ARO-1)
(AD-698018; RAC-TP-380) Avail: CFSTI CSCL 12/2

The paper extends the algorithm described in a previous report to problems in which the objective function and the constraint functions are the sums of functions of the various decision variables. The important feature of the algorithm is that the global solution to a problem will be found even if the objective function is not convex and the feasible region is not a convex set. Author (TAB)

N70-20936# Tokyo Univ. (Japan). Inst. for Nuclear Study.
TABLES OF GREEN FUNCTIONS
Hiromasa Hirakawa Jun. 1968 125 p
(SJC-A-68-3) Avail: CFSTI

Tables of Green functions frequently required in accelerator physics and related fields are presented. Regions of practical interest considered include three-dimensional regions in circular cylinders and also between parallel plates, and two-dimensional regions for a circle and also an infinitely long strip. Tables of Green functions of the first and second kinds are presented to six decimal places on the lattice points of variables at intervals of 0.1 for distances and 7.5 deg for angles. NSA

N70-20952# Akademiya Nauk URSR, Kiev.
APPLICATION OF A TRANSFER FUNCTION UNDER NONZERO INITIAL CONDITIONS
Yu. N. Bobkov *In its* Questions on the Theory of Elec. Circuits for Conversion of Measuring Inform. 1967 p 9-18 refs In RUSSIAN (See N70-20951 08-09)
Avail: CFSTI

An attempt is made to determine the conditions under which a type of compensation of equation members is feasible as determined by initial conditions and on the basis of this to extend the application of the transfer functions. The conditions of mutual compensation of the equation numbers are examined which yield the possibility of applying the transfer functions under nonzero initial conditions without regard to these conditions. B.E.S.

N70-21027# Purdue Univ., Lafayette, Ind. Krannert Graduate School of Industrial Administration.
MULTICOMMODITY NETWORK FLOWS
B. Rothschild and A. Whinston 1 Nov. 1969 15 p refs
(Contract N00014-67-A-0226-0006)
(AD-697691) Avail: CFSTI CSCL 12/2

The purpose of this article is to survey the current literature on multicommodity network flows. The study of multicommodity flows is concerned with generalizing the results which are known for single commodity flows in networks. These results fall into three broad categories: optimization, computation and structure. The optimization category includes the question of maximizing flow or minimizing cost in a network. The computation question involves finding algorithms for efficiently computing flows. And the structural results relate the flows to structural properties of the network (e.g., the Max-flow Min-cut Theorem). Because of the added complexity of having many commodities, the results for multicommodity flows sometimes require methods different from those used for analogous single commodity results. As in the one-commodity case, the question of finding a maximal multicommodity flow can be stated as a linear programming problem. In general for n-commodity flow there is the question of feasibility. That is, not only do we wish to know how much flow can be achieved, but more specifically how much of each kind of commodity. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also 13 Geophysics; and 30 Space Sciences.

N70-19920# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astron., and Space, No. 219 2 Jan. 1970 p 7-29 refs (See N70-19918 08-13)
Avail: CFSTI

Abstracted data are presented on radiosondes, cloud particle size and concentration, radio propagation, electric fields in free atmosphere and thunderstorms, weather modification and prediction, applications to aviation, and related topics. N.E.N.

N70-19940 National Lending Library for Science and Technology, Boston Spa (England).
PRECIPITATION AND LUNAR PHASES
A. Gabilly 28 Nov. 1969 18 p refs Transl. into ENGLISH from J. Mec. Phy. Atm. (Paris), no. 6, p 129-143
(NLL-M-7877-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

The variation in precipitation within the period of the lunar month is studied, ie the 29 day period including the new moon and the subsequent 28 days, and also the 28 days preceding the new moon: this takes into account the variability in the length of the lunar months which is sometimes 29 and sometimes 30 days. The period studied is from 1944 to 1964. Three French meteorological stations, each with different climates were chosen. An increase in rainfall seems to occur immediately after the full moon, in relation to the preceding and subsequent periods. Several tests seem to indicate that this slight increase is not due merely to chance. Author

N70-19960 National Lending Library for Science and Technology, Boston Spa (England).
ELABORATION OF CLIMATIC DIRECTIVES FOR TOWN PLANNING ON THE EXAMPLE OF THE CITY OF BAGDAD
S. Zych et al 28 Nov. 1969 11 p refs Transl. into ENGLISH from Przeglad Geof. (Warsaw), no. 13, 1968 11 p
(NLL-M-7878-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

An example is presented on how to use methodically climatological data for town planning. An extension to the city of Bagdad was planned. Author

N70-20002 National Lending Library for Science and Technology, Boston Spa (England).
THE OBJECTIVE CHECKING OF INITIAL DATA FOR STATIONS OF THE NORTHERN HEMISPHERE BY THE METHOD OF OPTIMAL INTERPOLATION
S. I. Gubanova 28 Nov. 1969 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 4, 1964 p 78-86 In ENGLISH; partly in RUSSIAN
(NLL-M-7852-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

An operational objective analysis system which finds and rejects incorrect upper air data in one stage for the Northern Hemisphere is discussed. The error detecting possibilities presented by static control, which is based on the approximation of atmospheric motions being quasi-stationary is described as effective in finding errors due to distortion of temperatures or heights at sounding stations, by comparing the deviations in height with the standard error of optimal interpolation, after the interpolation weights have been determined. When the deviation is not satisfied after successive eliminations it can be discarded and since it is not considered part of a network, it is not necessary to recalculate data for other regions. F.O.S.

N70-20048# Institute for Storm Research Inc., Houston, Tex.
FORECAST METHODS FROM SATELLITE PHOTOGRAPHS Final Report, 1968-1969
John C. Freeman, Pieter Feteris, Sam Rosenberg, Keith Veigas, and Troxel Ballou Jun. 1969 62 p refs
(Contract N62306-68-C-0289)
(AD-697940; ISR-45) Avail: CFSTI CSCL 4/2

Two models of atmospheric flow, compensation and moist over-compensation are found to be useful in the study of tropical weather in conventional and satellite observations. A numerical weather prediction model simulating important physical processes in the low latitudes is developed to test the feasibility of using ATS information to infer future weather distribution. Diagnostic studies using ATS films and conventional synoptic weather maps describe the weather situations in the Central North Pacific in terms of the theoretical models. Results of the prediction experiment and future use of ATS type data in numerical prediction models are discussed and application recommended. Appendix A gives a description of one method of following cloud motion in satellite photographs. Author (TAB)

N70-20066*# National Aeronautics and Space Administration, Washington, D.C.
AERONOMY AND METEOROLOGY
In its Rept. to COSPAR, French Space Program Feb. 1970 p 23-46 refs (See N70-20064 08-30)
Avail: CFSTI

Some important points concerning aeronomy and meteorology are discussed. Among the topics covered are: the high atmosphere, atmospheric tides, gravity waves, turbulent phenomena, variations in intensity of the OH emission during twilight, distribution in altitude of exospheric atomic hydrogen, solar X-rays, the D-2A satellite, Eolus project, flight tests with constant-level balloons, balloon equipment, dispersion of Lagrange tracers, analysis of wind measurements by the Eolus balloons, synoptic studies of the cloud cover from data received from satellites, cloud patterns, convective phenomena, infrared constrast between earth and space, atomic oxygen distribution, and atmosphere analysis device capable of being carried by a sounding balloon. Author

N70-20107 National Lending Library for Science and Technology, Boston Spa (England).
THE RADAR METHOD OF SPIRAL SCANNING AT CONSTANT HEIGHT
K. S. Zupahin et al 28 Nov. 1969 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 224, 1968 p 91-101
(NLL-M-7844-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Meteorological radar equipment and procedures for the spiral scanning of clouds at a given height are described. The radar reflectivity and geometrical dimensions of the clouds can be determined directly in the process of recording. For scanning within a radius of 100 km, a cycle of observations takes about 4 minutes. The amount of detail in the recording can be varied by simple modifications of the apparatus, so that the method can be used in experimental research on clouds, operational observations and, in particular, the modification of clouds. Equipment parameters include: wavelength 3.2 cm, power of pulse 100 to 200 kw, duration of sounding pulse 1 to 2 microseconds, frequency of pulses 800 to 1,000 per second, and sensitivity of receiver 10 to the -13th power w. Preliminary operating results support the feasibility of producing an inexpensive, uncomplex, and reliable apparatus to automatically measure and process radar signals from clouds and precipitation zones. E.M.C.

N70-20113 National Lending Library for Science and Technology, Boston Spa (England).
ON THE ACCURACY OF ANALYSES OF THE GEOPOTENTIAL FIELD OVER THE NORTHERN AND SOUTHERN HEMISPHERES
Ju. M. Liberman 28 Nov. 1969 9 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 228, 1968 p 41-48 In ENGLISH; partly in RUSSIAN
(NLL-M-7850-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupon

A brief account is given of the theory and technique of estimates of the accuracy of analyses of meteorological fields and their finite differences. Using this technique he makes calculations to evaluate the plan proposed by the WMO in 1966 for expanding the existing network of aerological stations. He shows that, from the point of view of the accuracy of objective analyses, and so of the numerical forecasting of meteorological fields, the plan proposed is not optimal. Quantitative estimates show that errors in objective analysis over the northern hemisphere can be substantially reduced by disposing the additional, stations otherwise. The first estimates are made of relative errors in the analysis of geopotential over the southern hemisphere. Lack of information about the variability of geopotential over the Southern hemisphere hinders the calculation of absolute errors. Author

N70-20179# Deutscher Wetterdienst, Offenbach, am Main (West Germany).
MONTHLY AND YEARLY AVERAGES OF AIR TEMPERATURE AND PRECIPITATION IN THE FEDERAL REPUBLIC OF GERMANY FOR THE PERIOD 1931-1960 [LANGJAEHRIGE MONATS- UND JAHRESMITTEL DER LUFTTEMPERATUR UND DES NIEDERSCHLAGS IN DER BUNDESREPUBLIK DEUTSCHLAND FUER DIE PERIODE 1931-1960]
Hans Schirmer 1969 55 p refs In GERMAN; ENGLISH summary *Its* Ber. Vol. 15, No. 115
Avail: CFSTI

For the normal period 1931-1960 recommended by the World Meteorological Organization (WMO) average values of the air temperature and the precipitation are given for the individual months and the year from a selection of stations of the Federal Republic of Germany. The spatial distribution of both elements as well as the average annual fluctuation of the air temperature are based on the results of an essentially larger numer of stations (air temperature: more than 700, precipitation: more than 5000). The position of the 195 stations can be seen on map 1. A short text contains the main explications necessary for a correct interpretation of the data and maps. Author

N70-20279# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 110, NO. 1: KINEMATIC STUDY OF AN ALMOST ADIABATIC-QUASISTATIONARY DRIFTING CYCLONE [METEOROLOGISCHE ABHANDLUNGEN. BAND 110, HEFT 1: KINEMATISCHE STUDIE AN EINER NAHEZU ADIABATISCH-QUASISTATIONAER DRIFTENDEN ZYKLONE]
Johannes Clauss 1969 72 p refs In GERMAN; ENGLISH summary
Avail: CFSTI

This paper deals with the occluded cyclone having crossed the Great Lakes of North America nearly stationarily southeastward 18th of January 1965 00 GMT. The author shows how the upgliding and the subsiding synoptic-scale flow can be calculated in a co-ordinate system connected with the drifting cyclone, supposed a dry-adiabatic relation of piazotropy exists. The trajectories are demonstrated intuitively in selected isentropic surfaces with the help of two wire models. Some interesting conclusions are made for the behavior and efficiency of frontal processes and for the structure of the involved airmasses. Author

N70-20280# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 106, NO. 2: DAILY ALTITUDE MAPS OF THE 100 mb LEVEL AND THE 50 mb LEVEL AS WELL AS MONTHLY MEAN MAPS FOR 1969, PART 2 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 106, HEFT 2: TAEGLICHE HOEHENKARTEN DER 100 MB-FLAECHE UND DER 50-MB-FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DASJAHR 1969. TEIL II, VIERTELJAHR]
Barbara Kriester, Karin Labitzke, Renate Lenschow, Wolfgang Roeder, Richard Scherhag et al 1969 92 p refs In GERMAN
Avail: CFSTI

The presented Northern Hemisphere daily and monthly average charts for the 100 mb and 50 mb heights levels cover the second quarter of 1969. The processes are governed by the change from spring to summer circulation patterns with a clearly marked temperature increase already starting in February; the April temperature distribution in the lower stratosphere was characteristically summery. Transl. by G.G.

N70-20281# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 104, NO. 2: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION, BERLIN-TEMPELHOF, OF THE INSTITUTE FOR METEOROLOGY AND GEOPHYSICS OF THE FREE UNIVERSITY BERLIN, FEBRUARY 1969. DAILY MEASUREMENT RESULTS, MONTHLY EVALUATION AND CLIMATOLOGICAL DATA, AS WELL AS MEASUREMENT RESULTS FROM SPECIAL ASCENTS [METEOROLOGISCHE ABHANDLUNGEN. BAND 104, HEFT 2: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPLEHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1969 FEBRUAR. TAEGLICHE MESSRESULTATE, MONATLICHE BEARBEITUNG UND KLIMATOLOGISCHE WERTE, SOWIE MESSERGEBNISSE VON SPEZIALAUFSTIEGEN]
Eugen Pantzke, Richard Scherhag et al 1970 186 p refs In GERMAN; ENGLISH summary
Avail: CFSTI

The detailed results of the radiosonde ascents performed by the aerological station of Berlin are presented. Using these data monthly time cross sections of the averaged temperature and the zonal and meridional wind components in heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature and velocity of sound, were extracted for all standard pressure surfaces, several height levels, the tropopause and the freezing level. The data of the ozone-ascents were given in tabular and graphical form. Author

N70-20404# Weather Wing (4th), Ent AFB, Colo. Aerospace Sciences Div.
VISIBILITY IMPROVEMENT GRAPHS. A SYNOPTIC CLIMATOLOGICAL FORECAST AID
Robert C. Sabin Nov. 1969 31 p refs
(AD-697960; WW-TP-69-5) Avail: CFSTI CSCL 4/2

The paper describes a new technique for producing a useful synoptic climatological forecast aid which is different from the conventional climatological product. Data is limited to a specific weather element (radiation fog) associated with a specific synoptic weather regime. Thus, it is probably the first true synoptic climatological forecast tool. Its superiority over aids which do not take the synoptic pattern into account is clearly evident. Author (TAB)

N70-20415*# Bellcomm, Inc., Washington, D.C.
ATMOSPHERIC TEMPERATURE PROFILES USING SATELLITE-BORNE LASER
W. A. Gale 13 Jan. 1970 21 p refs
(Contract NASw-417)
(NASA-CR-108907; TM-70-1011-1) Avail: CFSTI CSCL 04B

A system for obtaining vertical temperature profiles of the atmosphere from a satellite is discussed. A carbon dioxide laser sends a signal which is either tunable over a 2 GHz range or contains a range of frequencies simultaneously. This signal is reflected from the earth's surface or ocean and is received back at the satellite. The returned signal at each frequency is analyzed for absorption due to carbon dioxide in the atmosphere by comparison with a nearby standard. Continuous transmitter tuning is not possible now, but isotopic production of a range of frequencies potentially provides enough information. From absorption as a function of frequency, temperature as a function of altitude can be deduced. The application to coorbiting satellites is discussed and some laboratory measurements are suggested. Author

N70-20453# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM TEMPERATURE GRADIENT: SELECTED ARTICLES [RAVNOVESNYY GRADIYENT TEMPERATURY: SBORNIK STATEI]
M. I. Yudin et al 23 May 1969 34 p refs Transl. into ENGLISH from Gidromet. Izdat. (Leningrad), 1967 20 p
(AD-695904; FTD-MT-24-86-69) Avail: CFSTI CSCL 4/2

Contents: U.S. board on geographic names transliteration system; Turbulent heat flux in the boundary layer of the atmosphere; and Turbulence in the atmospheric surface boundary layer. TAB

N70-20457 National Lending Library for Science and Technology, Boston Spa (England).
SOME PROBLEMS IN THE OBJECTIVE ANALYSIS OF THE WIND FIELD
M. O. Kricak 28 Nov. 1969 10 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), v. 228, 1968 p 87-97
(NLL-M-7773-(5828.4F) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

An empirical estimate was made on the interpolation accuracy for wind measurement. Comparative data was obtained at three levels for nine atmospheric situations. A method of calculating the geostropic wind from weather station data is proposed based on a geometrical approach. Finite differences and differential of geostropic wind, real wind and geostropic differential, and real and geostropic finite differences were correlated. The use of wind measurement interpolation is recommended for automatic control of initial wind data processing. J.A.M.

N70-20488 National Lending Library for Science and Technology, Boston Spa (England).
THE VECTOR CORRELATION OF THE WIND FROM TIME SERIES OF OBSERVATIONS
Ju. N. Kozlov 21 Oct. 1969 8 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluz., Met. Gidr., (Leningrad), no. 2, 1969 p 88-91
(NLL-Trans-M-7814-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Empirical time correlation functions of wind vectors at heights of 2, 4, 7, 10, 13, 16 and 20 km and correlation functions of wind components along the coordinate axes are given for winter and summer. The author concludes that the time correlations of the wind are not persistent. The results are based on wind sounding of the atmosphere up to 20-25 km over Moscow in IGY and IGC. Author

N70-20500 National Lending Library for Science and Technology, Boston Spa (England).
FORECASTING A SNOWMELT VOLUME IN REGIONS OF HIGH MOUNTAINS
U. Soczynska 1969 12 p refs Transl. into ENGLISH from Inst. Hydr.-Met., Wiad. Sluzby Hyd. Met. (Warsaw), no. 4, pt. 2, 1968 p 23-33
(NLL-M-7873-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Forecasting spring floods caused by thaws of snow and rainfall is discussed. An analysis of flood formation was made on the model of the R. Dunajec basin between Nowy Targ and Kowaniec. Air temperature gradients were derived, to adjust for unequal distributions by area. Zero deg C isotherm heights were obtained on the basis of the hypsometric curve and these gradients, for a range of mean daily air temperatures at Zakopane control station. The quantity of heat received by this area was computed, assuming various air temperatures at Zakopane. With the assistance of a degree-day factor, calculation is possible of the loss of water stored in the snow cover for one day, or other period. For this a special nomogram was prepared. From the analysis of hydrometeorological factors, equations were obtained for computing the run-off volume and run-off coefficient as a function of the water loss from the snow and precipitation. Author

N70-20501# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW. SCIENTIFIC RESEARCH INSTITUTE OF AEROCLIMATOLOGY TRANSACTIONS: SELECTED ARTICLES
T. N. Anisimova et al 24 Sep. 1969 68 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), no. 52, 1968 16 p
(AD-696920; FTD-HT-23-281-69) Avail: CFSTI CSCL 4/2

Contents: Continuous duration of wind speeds under the conditions of the Plains areas in the USSR; Approximate calculation of wind speed in the 100 meter atmospheric surface boundary layer for the central regions of European USSR; Diurnal variation of wind speed in the atmospheric planetary boundary layer. TAB

N70-20556 National Lending Library for Science and Technology, Boston Spa (England).
DIFFUSE WATERSPOUTS OR WHIRLWINDS AND THEIR RECORDING
D. V. Nalivkin 28 Nov. 1969 20 p Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluz., Met. Gidr., (Leningrad) no. 1, 1969 p 93-95
(NLL-Trans-M-7857-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The narrow boundary separating slowly moving air from that moving at supersonic speeds is described for different cases of observed whirlwinds. The characteristics of diffuse whirlwinds are compared with dense storms. It is concluded that both types of phenomena should be included under the same classification of whirlwinds. The distinguishing feature of whirlwinds as opposed to storms is the sharply defined path of the whirlwind along its direction of motion. Examples are given of objects and living organisms being picked up by whirlwinds in the USSR. R.B.

N70-20558 National Lending Library for Science and Technology, Boston Spa (England).
THE FILTRATION OF COMPUTING NOISE IN THE PROCESS OF NUMERICAL FORECASTING
L. N. Strizevskij 28 Nov. 1969 13 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Cent. SSSR, Gidromet. (Leningrad), v. 29, 1968 p 58-71 In RUSSIAN and ENGLISH
(NLL-M-7879-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

The parametric densities of the exact and finite-difference solutions are found for the barotropic forecasting equation. Filtration of computer noise for a given forecasting scheme has a noticeable effect at time intervals exceeding 1.0 to 1.5 hours. Greater accuracy is achieved and errors are reduced when filtration is used. The time interval is increased because parasitic waves propagate at a speed inversely related to the time interval due to boundary condition instability. R.B.

N70-20575# Army Foreign Science and Technology Center, Washington, D.C.

STATISTICAL STRUCTURE OF AEROLOGIC FIELD ANOMALIES OVER NORTH AMERICA

R. L. Kagan et al 14 Nov. 1969 33 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 228, 1968 p 98-120

(AD-698079; FSTC-HT-23-007-70) Avail: CFSTI CSCL 4/2

For making an objective analysis of aerologic field anomalies it is necessary to accumulate data on their statistical structure. Until recently few such data were available due to the difficulty of making the required computations manually. The availability of electronic computers has now made it possible to compute such characteristics. As the initial material we used data on the mean monthly values of geopotential and temperature at the 500-mb isobaric surface for the ten years from 1956 to 1965 as published by the United States Weather Bureau. The authors selected 48 aerologic stations located in the United States and Canada. Using these data for both elements for each month separately the authors computed the mean values and the mean square deviations for each station and also the spatial autocorrelation functions to distances of about 6,000 km. Author (TAB)

N70-20614 National Lending Library for Science and Technology, Boston Spa (England).

THE DETERMINATION OF VERTICAL MOTIONS IN RAIN BY MEANS OF DOPPLER RADAR

A. G. Gorelik et al 28 Nov. 1969 7 p Transl. into ENGLISH from Izv. Akad. Nauk SSR, Fiz. Atmos. Okean. (Moscow), no. 5, 1969 p 543-545

(NLL-M-7870-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The measurement of vertical currents in clouds and precipitation is studied as an important problem of meteorology, since it is required for a more complete understanding of the process which leads to precipitation formation. The most effective of the various methods of assessing vertical currents is considered to be the radar method based on the use of radard working on the Doppler principle. In the present paper the vertical velocity in rain is found with few artificial assumptions. It is assumed that, in the general case, the distribution of droplet diameters has the form Nd-n e -bd(-), where N, n and b are parameters of the distribution. To approximate the relationship between the gravitational velocity of a droplet and its diameter K. S. Sifrin's universal formula for the speed at which a sphere falls in a fluid is used. Author

N70-20615 National Lending Library for Science and Technology, Boston Spa (England).

THE RECONSTRUCTION OF THE FIELD OF SURFACE PRESSURE FROM METEOROLOGICAL SATELLITE DATA

O. S. Bogomolov [1969] 6 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 221, 1968 p 127-131

(NLL-M-7846-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A method of reconstructing vertical velocities, stream functions and geopotential heights at the middle level of the atmosphere from satellite cloud cover data is studied for determining surface pressure fields. To assess the possibility of reconstructing the surface pressure field from cloud cover data, a region bounded by the 35 and 75 N parallels and the O and 60 E meridians was chosen. In January 1967, five calculations of the generalized parameter of the surface pressure field based on cloud cover were accomplished. The pressure field is constructed from cloud data as follows: (1) The initial field is expanded as a Fourier series on each row of the grid. (2) From the Fourier coefficients obtained, the Fourier coefficients of the Laplacian field are found by regression equations. (3) The Poisson equation for the pressure field is solved with the given actual values on the boundaries of the region considered. The results are considered in good qualitative agreement with the actual pressure fields. F.O.S.

N70-20643 National Lending Library for Science and Technology, Boston Spa (England).

AUTOMATIC CONTROL OF DAILY DATA ON THE BASIC METEOROLOGICAL OBSERVATIONS

I. V. Nazarova 1969 31 p refs Transl. into ENGLISH from the publ. "Survey of the Present Condition of Means and Methods for the Mechanized Processing of Meteorological Information in Various Countries" p 54-108

(NLL-M-7859-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, 1 Engl.: 3 NLL photocopy coupons

A method for the more precise control of data in the second stage is presented. A code for entering data on punched tape is described. A method of controlling illogicalities and variation of elements from one observation time to another is applied to the control of data on cloudiness, atmospheric phenomena, visibility, the state of the soil surface, and wind direction. Algorithms are given for the control of snow cover using diurnal relationships between one element and another. Data on air temperature, soil surface temperature, air humidity, air pressure, and wind speed are controlled by time interpolation. N.E.N.

N70-20697 National Lending Library for Science and Technology, Boston Spa (England).

THE APPLICATION OF THE THEORY OF FILTRATION OF RANDOM PROCESSES TO SOME PROBLEMS IN OBJECTIVE ANALYSIS

B. V. Ovcinskij 28 Nov. 1969 27 p refs Transl. into ENGLISH from Tr. Gidromet. Nauchn.-Issled. Cent. SSSR (Leningrad), no. 19, 1968 p 44-57 In ENGLISH and RUSSIAN

(NLL-M-7863-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Formulae are derived for computing weighting functions for use in the processes of optimal interpolation and smoothing of meteorological elements on the supposition that the correlation functions for the true values (signals) and the errors of observation (noise) are known. Author

N70-20796# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

RADAR CRITERIA FOR THE CLASSIFICATION OF THUNDERSTORM AND SHOWER ACTIVITY

R. E. Gibson 22 Sep. 1969 13 p refs Transl. into ENGLISH from Meteorol. i. Gidrol., (Moscow), no. 4, 1969 p 79-83

(Contract NOW-62-0604-C)

(AD-697825; APL-CLB-2-T-609) Avail: CFSTI CSCL 4/2

The report contains methods for numerical analysis of radar information that make possible the detection of the existence of cumulonimbus clouds with high statistical reliability and the location of areas of thunderstorms and shower activity in them. Numerical criteria based on a knowledge of the spatial distribution of the upper edge of the radar echo and its intensity at two altitude levels are presented. Author (TAB)

N70-20837 National Lending Library for Science and Technology, Boston Spa (England).
ON THE DIURNAL COURSE OF EVAPORATION FROM WATER SURFACE [O DOBOWYM PRZEBIEGU PAROWANIA ZPOWIERZCHNI WODY]
D. D. Demianczuk 28 Nov. 1969 6 p refs Transl. into ENGLISH from Przegl. Geofiz. (Warsaw), no. 8, 1963 p 89-92
(NLL-M-7880-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Discrepancies in formulas used for calculating diurnal variations in water surface evaporation are discussed. The discrepancies are related to the treatment of the coefficient of turbulent diffusion, the height of the quasi-stationary air layer, air density calculations, the differential of water vapor elasticity, and solar effects on monthly total evaporation from a water surface. E.C.

N70-20854*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
NEAR INFRARED LIGHT SCATTERING BY TERRESTRIAL CLOUDS
James E. Hansen and James B. Pollack (Cornell Univ., Ithaca, N.Y.) [1969] 63 p refs
(Grants NGL-33-010-082; NGL-33-008-012; NSF GA-1086)
(NASA-TM-X-62818) Avail: CFSTI CSCL 04B

Calculations of the reflectivity of water clouds (liquid and ice particles) are compared to observations of terrestrial clouds in the near infrared. Topics presented are: new Mie scattering calculations of general interest, multiple scattering results to cloud observations, a revision in the optical constants of ice, and the appendix details several methods which substantially reduce the work load in multiple scattering computations. Results indicate that it is possible to use the spectral variation of the reflectivity to derive the size of the cloud particles and their phase (liquid or solid) as well as the total optical depth of the clouds. Typical results show dense cirrus clouds to have an optical depth less than or equal to 10 and to be composed of ice particles of mean radius 15-20 microns; the cumulus clouds which were analysed showed a more variable, but usually smaller, particle size. Author

N70-20889 National Lending Library for Science and Technology, Boston Spa (England).
DISSIPATION OF RADIATION FOG
A. E. Valencia et al 21 Oct. 1969 9 p refs Transl. into ENGLISH from Inst. Nac. Geof., Rev. Geof., (Madrid), v. 27, 1968 p 63-81
(NLL-Trans-M-7819-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Evaluated is the relationship between temperature of dissipation and dew point temperature and its effect on radiation fog dissipation. Analysis of climatological data from the Matacan weather station for the time 1945 to 1964 showed that the dew point or saturation temperature is the meteorological element that determines the time of fog dissipation. G.G.

N70-20910 National Lending Library for Science and Technology, Boston Spa, (England).
THE DETERMINATION OF THE NUMBER OF INDEPENDENT STATIONS EQUIVALENT TO A GIVEN SYSTEM OF CORRELATED STATIONS
M. G. Ter-Mkrtvjan 28 Nov. 1969 26 p refs Transl. into ENGLISH from Giva. Uprav. Gidromet. Sluv. Met. Gidr. [Leningrad), no. 2, 1968 p 34-36 In ENGLISH and RUSSIAN
(NLL-M-7865-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 photocopy coupons

A mathematical model is developed for determining the number of homogeneous, independent meteorological stations equivalent to a given system of correlated stations. This is considered of value in finding the significance of an apparent advantage in a new forecasting method, and in determining whether or not the number of predictors should not be too large. An illustration is given showing the relationship between geopotential heights at different levels during cold intrusions, and it is felt that fewer independent stations would be needed to give the same amount of information. N.E.N.

N70-20911 National Lending Library for Science and Technology, Boston Spa (England).
ATMOSPHERIC CIRCULATION IN THE TROPICS
S. P. Hromov 28 Nov. 1969 34 p refs Transl. into ENGLISH from Contemp. Probl. Clim. (Leningrad), 1968 p 176-201
(NLL-M-7855-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .4 NLL photocopy coupons

Various problems in tropical meteorology are considered. These include the relationship between the basic transfer and disturbances in the mechanism of air, energy, and angular momentum exchange, upper air climatological picture of the Indian monsoons, types of tropical disturbance, structure of the intertropical convergence zone, and the structure and formation of tropical hurricanes. Author

N70-20942# National Weather Records Center, Asheville, N.C.
CLIMATOLOGICAL SUMMARIES. VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 33: PORTLAND, OREGON. PORTLAND INTERNATIONAL AIRPORT Final Report
Jun. 1969 33 p
(Contract FA-67-WAI-129)
(AD-697681; FAA-RD-69-22-Vol-33) Avail: CFSTI CSCL 17/7

The report consists of climatological data for Portland International Airport, Portland, Oregon. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-20993# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CENTRAL AEROLOGICAL OBSERVATORY: SELECTED ARTICLES
V. D. Litvinova et al 23 May 1969 63 p refs Transl. into ENGLISH from Tsentralnaya Aerol. Obs. (Moscow), no. 78, 1967 p 57-62; p 80-108
(AD-696556; FTD-MT-24-41-69) Avail: CFSTI CSCL 4/1

Contents: Daily variation in the turbulence coefficient above flat terrain; Theory of spatial-temporal correlation of velocities in an isotropic turbulent flow; Turbulence spectrum of a stably stratified atmosphere. TAB

N70-21079# Kyoto Univ. (Japan). Research Reactor Inst.
DIFFUSION CLIMATOLOGY OF RESEARCH REACTOR INSTITUTE, KYOTO UNIVERSITY
1968 21 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-54) Avail: AEC Depository Libraries

The Kyoto University Reactor (KUR) at the Research Reactor Institute, Kyoto University has been improved so that its heat rating has been raised from one to five megawatts. Prior to this improvement, the diffusion climatology of the KUR site was investigated as a part of the safety analysis of KUR. Annual percentage frequencies of wind direction are 13% for S, 9% for WNW and NW, 8% for ENE and SSW, and 6% for E. The sum of the six winds amounts to more than 50% of a year. WNW and NW winds mainly occur in the daytime and E, S, and SSW mainly in the nighttime. Harmonic means of wind speed are 3.3 miles/sec for WNW, 2.8 miles/sec for NW, 2.0 miles/sec for SSW, 1.8 miles/sec for ENE, 1.7 miles/sec for E, and 1.6 miles/sec for S. Author (NSA)

N70-21092 National Lending Library for Science and Technology, Boston Spa (England).
THE STATISTICAL STRUCTURE OF ANOMALIES IN AEROLOGICAL FIELDS OVER THE NORTH AMERICAN CONTINENT
R. L. Kagan et al. 28 Nov. 1969 20 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 228, 1968 p 98-120
(NLL-M-7860-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .4 NLL photocopy coupons

A statistical anslysis is given based on monthly mean 500 mb heights and temperatures for 1956-1965, published in the monthly reports of the United States Weather Bureau for the United States and Canada. The accuracy of the monthly means is discussed, and the standard deviation of the means is determined. The space structure is calculated, based mainly on the standardized correlation function. Determinations were made of correlation coefficients between the anomalies at pairs of stations for each pair of stations and each month. N.E.N.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-19711*# Texas Univ., Austin. Astrodynamics Research Lab.
GUIDANCE METHODS FOR LOW-THRUST SPACE VEHICLES Cumulative Progress Report, 1 Jan. 1969 - 31 Jan. 1970
B. D. Tapley and W. T. Fowler 31 Jan. 1970 46 p refs
(Grant NGR-44-012-008)
(NASA-CR-108235) Avail: CFSTI CSCL 17G

The performance of optimal deterministic control schemes based on the first variation of the calculus of variations is evaluated. Members of the family of control schemes based on the gradient method of trajectory optimization are compared. Guidance techniques based on the second variation are compared with first order methods. A comparison is presented for a series of optimal low-thrust Earth-Mars transfer missions. Author

N70-19867*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LARGE ANGLE METHOD FOR SPACE VEHICLE ANGULAR MOMENTUM DESATURATION USING GRAVITY GRADIENT TORQUES
Hans F. Kennel 14 Oct. 1969 34 p refs
(NASA-TM-X-53958) Avail: CFSTI CSCL 17G

The angular momentum desaturation method is based on the use of the gravity gradient torques. Large angular maneuvers maximize the effectiveness of the desaturation method for the case where the mission requires the minimum moment-of-inertia axis to point toward some celestial object for the nonocculted part of the orbit. The desaturation method is developed under the assumption that the difference between two of the principal moments of inertia is negligible. A constant attitude with respect to the gravity gradient direction is held during the desaturation period. This allows maximization of the available gravity gradient desaturation torque which is necessary since the assumed moment of inertia distribution (in relation to the mission requirements) is a very poor candidate for angular momentum desaturation using the gravity gradient, especially when relatively large aerodynamic disturbance torques are present. Author

N70-19972# Hollandse Signaalapparaten N.V., Hengelo (Netherlands).
TACTICAL AIR TRAFFIC CONTROL
M. Staal *In* AGARD Tech. for Data Handling in Tactical Systems Dec. 1969 p 43-57 refs (See N70-19969 08-07)
Avail: CFSTI

Described is an integrated civil-military air traffic control system that allows for radar control and traffic planning by using flight progress boards equipped with computer controlled electro-mechanical alpha-numerical indicators and controller key boards. Radar consoles depict raw video on a selective basis and teleprinters provide input-output data for flight management and progress. Introduction of radar information into the computer system that connects flight progress boards and teleprinters is done manually. G.G.

N70-20468*# Lockheed Missiles and Space Corp., Sunnyvale, Calif. Space Systems Div.
PASSIVE SOLAR ARRAY ORIENTATION SYSTEM (THERMAL HELIOTROPE) Final Report, 23 Dec. 1968-23 Sep. 1969
D. R. Lott and R. C. Byxbee 23 Sep. 1969 115 p refs
(Contract NAS5-11637)
(NASA-CR-108919; LSMC-A963802) Avail: CFSTI CSCL 17G

The feasibility of simple passive tracking concepts using bimetal elements was investigated. Modes of sun-tracking were studied which included tracking axis, direction, unidirectional or bidirectional capabilities, reset vs continuous concepts, and the necessity of single or double axis rotation. Torque requirements were determined and tracking rates at typical various altitudes plotted. The torque and rates affect design of thermal heliotropes. A thermal and mechanical analysis was performed which identified factors affecting bimetal tracker performance. Among these factors were geometric parameters of coil size and shape, along with thermal coatings and shade configurations. The preliminary analysis led to several conceptual designs. Through an iterative process, these conceptual designs established a basis for construction of four working models. The models were tested in a simulated orbital environment to prove the concepts and study operating modes. Design parameters were developed for sizing thermal heliotrope motor and sensor elements including equations for optimizing bimetal element performance and minimizing volume and weight. A simple computer program indicates the relative merit of applying various thermal coatings on the bimetals. Author

N70-20573*# Stanford Research Inst., Menlo Park, Calif.
OPTIMIZATION STUDY OF A SINGLE THREE-GIMBALED CONTROL MOMENT GYRO Final Report
Yasutada Kashiwagi Dec. 1969 84 p refs
(Contract NAS1-7979; SRI Proj. 7204)
(NASA-CR-66904) Avail: CFSTI CSCL 17G

The feasibility study of using a single three-gimbaled control moment gyro is made for fine control of experimental modules attached to an orbital spacecraft. The suboptimal control laws are derived for the simplified equations, and these control laws performed very well for the original equations. These laws are feedback control laws. Three optimization problems are considered for the system. These are minimum time control, minimum energy control, and minimization of both time and energy with a weighting factor. Author

N70-20655*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A SIMPLIFIED DEAD RECKONING NAVIGATION SYSTEM FOR THE MANNED LUNAR ROVING VEHICLE
Walter L. Green 30 Sep. 1969 64 p refs
(NASA-TM-X-53953) Avail: CFSTI CSCL 17G

A dead reckoning navigation system for the manned lunar

roving vehicle is presented. The basic hardware for the system is two free gyros mounted to the frame of the vehicle, the wheel odometers and tachometers, and a signal processor. The mathematical equations for the navigation system are developed and related directly to the vehicle velocity and the gimbal angle readings. A digital simulation program is written for the navigation system for performing error analysis. The simulation can be used for determining the effects of gyro drifts and system misalignments for any selected lunar surface profile. The results of a study with selected ranges of gyro drift rates and misalignments for a particular surface profile are given. Author

N70-20684*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

PRECISION MAGNETIC ATTITUDE CONTROL OF SPINNING SPACECRAFT

John A. Sorensen Aug. 1969 285 p refs

(Grant NSR-05-020-379)

(NASA-CF-108977; SUDAAR-380) Avail: CFSTI CSCL 17G

A study is presented of the precision magnetic attitude control of rigid, earth orbiting spacecraft which are nominally spinning about their maximum axes of inertia. Specifically, control systems for accurately pointing the satellites' spin axes and maintaining nearly constant spin speed are investigated. The effects of environmental disturbances and incorrect vehicle parameters upon obtainable pointing accuracies are evaluated. The first control system studied is for axisymmetric vehicles operating in highly eccentric orbits, each with its spin axis constrained to point normal to the orbit plane. Another magnetic attitude control system investigated points the spin axis of a spacecraft precisely at a star. Finally, a method is developed for synthesizing continuous attitude control laws for nonsymmetric spinning vehicles. This technique allows the designer to provide arbitrary dynamic response to the vehicle and has direct application to magnetic attitude control. Author

N70-20763*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS AND VERIFICATION OF A SPACECRAFT WIDE-ANGLE ATTITUDE-CONTROL SYSTEM

Francis J. Moran and Bruce H. Dishman Washington Mar. 1970 42 p refs

(NASA-TN-D-5716; A-2863) Avail: CFSTI CSCL 17G

Attitude control to ensure stability of a spacecraft slewing through large angles was experimentally investigated. The investigation examined a control law synthesized from Euler's theorem on rotation, which states that any attitude change of a rigid body may be accomplished by a single rotation about the appropriate axis. A theoretical analysis showed that a system using the control law is globally stable. The investigation was performed using an air-bearing table to simulate the spacecraft, two gimbaled star trackers as position sensors, rate syroscopes to provide damping information, and reaction wheels as control-torquers. A digital computer was used as a real-time controller to determine the desired axis of rotation from the star-tracker gimbal outputs and to generate simultaneous commands to all torquers so that the table would rotate about the desired axis. Author

N70-20842*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

SOME ASPECTS OF ARTIFICIAL DAMPING OF THE LONGITUDINAL MOTIONS OF A WINGED SPACECRAFT IN THE EARTH'S ATMOSPHERE [NEKOTORYYE VOPROSY ISKUSSTVENNOGO DEMPFIROVANIYE PRODOL'NOGO DVIZHENIYA KRYLATOGO KOSMICHESKOGO LETATEL'NOGO APPARATA ATMOSFERE ZEMLI]

V. I. Rudis et al. Washington NASA Mar. 1970 17 p refs

Transl. into ENGLISH from Mekhan. Kosmich. Poleta (Moscow), 1969 p 146 - 160

(Contract NASw-2034)

(NASA-TT-F-12848) Avail: CFSTI CSCL 17G

The reasons for the deterioration of the dynamic characteristics of the damping contour when the control stick is free are investigated, and means to decrease this negative influence on the spacecraft are sought. The control system components are described and then presented in the form of a mechanical model for purposes of discussing the dynamic characteristics of the system. The conditions which must be satisfied to ensure no adverse effects on them are defined as a function of the position of the sliding rod. The influence of the parameters affecting the transition process of the damped control system is determined. It is found that the natural frequency of the control system must be much greater than that of the craft to eliminate its considerable influence on the damping contour, while with lower frequency systems, artificial damping must be introduced in part of the system. Author

N70-20924*# Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.

HYBRID ALTIMETER USING A STRAPDOWN INERTIAL NAVIGATION SYSTEM

Philippe Charles Jankowski (M.S. Thesis) Jan. 1970 104 p refs

(Grant NGR-22-009-229; DSR Proj. 70343)

(NASA-CR-109086; TE-36) Avail: CFSTI CSCL 17G

Several methods of combining the output of a strapdown inertial navigation system with an external measurement of altitude are investigated. This combined information is used in the computation of the gravity field vector of the earth in a manner which minimizes the error in the indicated position due to the component errors in the altimeters and the gyros. Two sub-optimal hybrid altimeter configurations are considered. The first mixes radar altitude, which contains no dynamic lag, with vertical acceleration; the second combines barometric altitude, which contains dynamic lag, with vertical acceleration. The steady state mean squared error of either hybrid system is not reduced by the inclusion of vertical acceleration data. The linear optimal filtering theory is applied to the problem of hybrid altimetry. It is shown that a combination of a radio altimeter, barometric altimeter, and vertical acceleration reduces the mean squared error in the estimate of altitude to a great extent. This accuracy is only lightly sensible to the error angle in tracking the vertical. Author

N70-20927*# Michigan Univ., Ann Arbor. Radio Science Lab.

STUDY AND EVALUATION OF THE OMEGA NAVIGATION SYSTEM FOR TRANSOCEANIC NAVIGATION BY CIVIL AVIATION Final Report

Robert E. Scott Aug. 1969 107 p refs

(Contract FA-68-WA-1962)

(AD-697699; FAA-RD-69-39) Avail: CFSTI CSCL17/7

The purposes of the study were to evaluate the accuracy of the Omega Navigation System operating in an airborne environment and the potential operational utility of the system for civil aviation. The error sources of Omega are identified, and their effect on the ability of an aircraft to maintain the desired flight track is evaluated. Characteristics of Omega which are pertinent to operation by civil aviation but which cannot be fully evaluated with available information are identified and recommendations for further investigations are given. The use of omega as a navigational aid with Omega signals continuously available at the input of the receiver, with compensation for lane loss, and with an appropriate phase-propagation model would allow air-craft operation at conventional aircraft speeds with rms cross-track deviations of 3 nmi if the 10.2 kHz carrier is used for position fixing. The most serious errors would result from failure of lane identification. Several methods of improving resolution reliability in airborne applications are given. Omega could be employed as a useful and valuable navigational aid if several potential problems can be resolved satisfactorily. While solutions to these problems can reasonably by expected with present technology, they have not been conclusively demonstrated. Author (TAB)

N70-21009# Collins Radio Co., Cedar Rapids, Iowa.
COMPUTER/SIMULATION STUDY OF AIR DERIVED SEPARATION ASSURANCE SYSTEMS IN MULTIPLE AIRCRAFT ENVIRONMENT Final Report
J. M. Holt and G. R. Marner Oct. 1969 85 p refs
(Contract FA-WA-4598)
(AD-697942; Rept-523-0761821-00111-M; FAA-RD-69-31) Avail: CFSTI CSCL 1/2

The report reexamines, in the light of present understanding, earlier concepts and conclusions reported in the three interim reports. The best current answers to the problems posed by the program objectives are presented. In addition, some important remaining problems are identified and, where possible, a new course of action that seems promising is recommended. Significant among these is the new light and new emphasis on collision avoidance afforded by the upcoming changes to ATC. TAB

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-19707*# Aerojet-General Corp., Azusa, Calif.
EVALUATION OF TANTALUM FOR MERCURY CONTAINMENT IN THE SNAP-8 BOILER
H. Derow, B. E. Farwell, E. B. Johnson, L. A. Kimura, J. C. Whipple et al Nov. 1969 76 p
(Contract NAS5-417)
(NASA-CR-72651; AEROJET-3680) Avail: CFSTI CSCL 18N

A series of tests were conducted to evaluate tantalum as a material for mercury containment in the SNAP-8 boiler. Mercury corrosion of tantalum was known to be minimal; therefore, the tests were designed to investigate various mechanical designs of the boiler structure containing tantalum. The results of the tests provided information for evaluating the effects on tantalum of air and polyphenyl ether (Mix-4P3E) contaminants in the mercury loop. The test results and their application to the SNAP-8 boiler are described. Author

N70-19715# Gulf General Atomic, San Diego, Calif.
SLIDER, A FORTRAN 5 PROGRAM FOR THE COMPUTATION OF THE RELEASE OF FISSION PRODUCTS FROM ONE-DIMENSIONAL MULTILAYERED FUEL CONFIGURATIONS
K. B. Jadhav and B. W. Roos 1 Aug. 1969 60 p
(Contract AT(04-3)-167)
(GA-8566) Avail: CFSTI

The SLIDER computer program written in FORTRAN 5 is described. The program calculates transient and steady state releases of fission products from one-dimensional multilayered fuel configurations. Author (NSA)

N70-19736# Idaho Nuclear Corp., Idaho Falls.
ANALYTICAL CHEMISTRY BRANCH ANNUAL REPORT, FISCAL YEAR 1969
Sep. 1969 291 p refs
(Contract AT(10-1)-1230)
(IN-1316) Avail: CFSTI

Progress in programs for analytical chemistry methods is described. Topics include: quality control, qualifications, analytical development, spectroscopy, chemical analysis, burnup determination of nuclear fuels, loss of fluid combined with emergency core cooling system for power reactors, and iodine absorbers for reactor atmosphere cleanup. M.H.E.

N70-19737# Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium).
IRRADIATIONS OF UO2-PUO2 CERAMIC FUELS WITH HIGH BURN-UP RATIOS. ORIENTATION EXPERIMENTS IN BOILING WATER CAPSULES
A. Lhost and B. Van Oytrijve d'Ydewalle Feb. 1969 79 p refs
/ts Special Rept-11
(Contract EURATOM-001-64-1-TRUB)
(EURAEC-2097; EUR-4014) Avail: CFSTI

The first three irradiation runs carried out in an instrumented BR-2 apparatus are described. This part of the program constitutes the orientation phase during which adjustments and improvements to the irradiation apparatus and the techniques used in the post-irradiation examinations were carried out. For this reason the average powers did not exceed 250 W/cm and the burn-up rates 10,000 MWd/t. Author (NSA)

N70-19758# Atomic Energy Establishment, Winfrith (England).
AN EXPERIMENTAL STUDY OF THE INTEGRAL PROPERTIES OF U 235 AND PU 239 IN AN INTERMEDIATE ENERGY SPECTRUM, AND COMPARISON WITH THEORETICAL PREDICTION
W. N. Fox, D. C. King, I. J. MacBean, H. H. W. Pitcher, and J. E. Sanders et al Apr. 1969 76 p refs
(AEEW-R-586) Avail: CFSTI

Integral experiments designed to provide a sensitive test of the U-235 and Pu-239 cross sections spectrum-averaged over the intermediate energy range from 10 eV to 10 keV are described. The measurements were made in a small test region of near-unit k-infinity installed in the zero-power reactor HECTOR. Results of the measurements are compared with theoretical calculations. NSA

N70-19778# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
METAL-COOLANT THERMAL INTERACTIONS AT HIGH TEMPERATURES: PRELIMINARY RESULTS FROM A LASER HEATING EXPERIMENT
A. J. Clare, R. B. Duffey, R. S. Hall, T. S. Playle, and D. H. Poole Sep. 1969 32 p refs
(RD/B/N-1448; FRPMC/RSWP/P-(69)-191) Avail: CFSTI

The significance of fuel-coolant thermal interactions in reactor safety is discussed and earlier experiments in this field are briefly reviewed. A pulsed laser was used to heat metal foil samples under water, and the resulting generation rates of water vapour were examined. The apparatus and techniques for measuring the various parameters of interest are discussed in detail. Preliminary results confirmed that the most significant parameters are the temperature of the foil and its degree of dispersion. A previously unreported phenomenon is described, which provides a mechanism for the support of hot metal particles above a liquid surface, with consequent low rates of energy transfer. Author (NSA)

N70-19777# Atomic Energy Establishment, Winfrith (England).
COARSE MESH CORRECTION FOR COLLISION PROBABILITIES
J. R. Askew Jun. 1969 10 p refs
(AEEW-M-889) Avail: CFSTI

A simple method, based upon diffusion theory, is shown to provide a useful correction to collision probabilities in circumstances where the flat emission density assumption made in their calculation has broken down. It is expected that the correction will be of use in design calculations, and especially to multi-cell (or synthetic) models of complicated reactor geometries where more refined models are not available. Author (NSA)

N70-19778# Atomic Energy Establishment, Winfrith (England).
A DESCRIPTION OF THE EQUIPMENT FOR TIME-OF-FLIGHT SPECTRUM MEASUREMENTS ON THE FAST REACTOR ZEBRA

I. H. Gibson, J. E. Sanders, and D. Jakeman May 1969 19 p refs
(AEEW-M-896) Avail: CFSTI

The pulsed source for the time-of-flight equipment consists of 14 MeV S-band linear electron accelerator, drift tube, and water-cooled uranium-molybdenum alloy target installed on the ZEBRA lattice. Neutrons are extracted via a probe tube inserted into the core and an evacuated flight tube with counting stations at 50, 97, and 200 m from the core center. Two types of neutron detector are described and also the Ferranti Argus 500 on-line computer which is used for data collection. The equipment is used for measuring the neutron energy spectra from the lowest energies up to about 1 MeV. Author (NSA)

N70-19814# Atomic Energy Establishment, Winfrith (England).
RESONANCE EQUIVALENCE PROCEDURE CONVENIENT FOR NUMERICAL USE
J. R. Askew May 1969 11 p refs
(AEEW-M-892) Avail: CFSTI

A procedure is outlined for calculating the value of the equivalent homogeneous hydrogen admixture, appropriate to complicated geometric configurations. In particular, the method deals with arrays containing dissimilar materials in close proximity and calculates the effect of heavy canning materials. The procedure is designed for use in a modular calculational scheme having an appropriate spatial solution module for the geometry needed. A test against established methods for the case of isolated fuel rods shows that the desired accuracy of approximately 2% in resonance events can be obtained even in extreme cases. Author (NSA)

N70-19817# Atomic Energy Establishment, Winfrith (England).
METHUSELAH 3: A FORTRAN PROGRAM AND NUCLEAR DATA LIBRARY FOR THE PHYSICS ASSESSMENT OF LIQUID-MODERATED REACTORS
M. J. Brinkworth Jan. 1969 26 p refs
(AEEW-R-631) Avail: CFSTI

METHUSELAH 3 has been developed from METHUSELAH 2 by introducing improvements and additional facilities into the program and by revising the nuclear data library. These developments are described, and information is given on the coding and usage of METHUSELAH 3 on the IBM 7030 (STRETCH) computer and of an improved version of METHUSELAH 2 on the KDF9 computer. Author (NSA)

N70-19825# Atomic Energy Establishment, Winfrith.
NOISE SPECTRA MEASURED ON THE DRAGON REACTOR PRIMARY HEAT EXCHANGERS
J. D. Cummins Sep. 1969 41 p refs
(AEEW-R-641) Avail: CFSTI

The frequency spectra of secondary water flow and tube wall temperatures were measured on Dragon primary heat exchanges. No indication of tube wall temperature oscillations leading to tube burnout was found from the noise spectra analyzed. Author (NSA)

N70-19828# Atomic Energy Establishment, Winfrith (England).
TOFFEE: A FORTRAN PROGRAMME FOR CALCULATING DIRECTED FLUX SPECTRA
J. D. MacDougall Aug. 1969 7 p refs
(AEEW-M-903) Avail: CFSTI

TOFFEE is a KDF9 program to edit the fine group (1/128 lethargy) cell fluxes obtained from a MURAL calculation into a suitable form for interpretation of experimental neutron spectrum measurements. The program may compute the flux spectrum arriving at the detector in a time-of-flight experiment for perpendicular or parallel plate orientation at the source plane in the reactor, or alternatively may compute the cell averaged spectrum which is the spectrum generally observed by within reactor spectrometers. In addition it is possible to calculate the effect on the spectrum of observing it with a Gaussian resolution function with a constant lethargy width. Author (NSA)

N70-19839# Babcock and Wilcox Co., Lynchburg, Va. Critical Experiment Lab.
PHYSICS VERIFICATION PROGRAM, PART 3 Quarterly Technical Report, Apr.–Jun. 1969
W. G. Pettus, M. N. Baldwin, G. T. Fairburn, and M. E. Stern Sep. 1969 44 p refs
(Contract AT(30-1)-3647)
(BAW-3647-14) Avail: CFSTI

Axial power distribution measurements are listed for the UO2 fueled cylindrical critical assembly located in Bay 2 of the Critical Experiment Laboratory. Physics measurements and design parameters are presented for the UO2 fueled Small Lattice Experiments. NSA

N70-19868# Nus Corp., Rockville, Md.
MH-1A PROTECTION SYSTEM REVIEW
John T. Stone, George C. Rudy, Charles A. Negin, and Urs Born Nov. 1969 132 p refs
(Contract DAAK-02-69-C-0708)
(AD-698038; NUS-616) Avail: CFSTI CSCL 18/9

The purpose of the MH-1A protection system review was to compare and evaluate the protection system design against proposed IEEE standards for protection system design and against other current design techniques. An accident analysis was performed that determined that the source range rod withdrawal accident (SRRWA) would result in core damage if the power range scram were to fail during the accident. A reliability analysis of the protection system provided protection system reliabilities for the present protection system with the present test frequencies and for an improved test program. Suggested protection system modifications included additions of -14 volt dc power supplies so that the transistor switches driving the scram control relays would be independent of one another. Also, additional testing switches and test indications are recommended for the process protection channels and the scram control relays. Author (TAB)

N70-19874# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.
ABNORMAL REACTOR OPERATING EXPERIENCES, 1966–1968
Oct. 1969 92 p refs
(Contract W-7405-eng-26)
(ORNL-NSIC-64) Avail: CFSTI

Incidents occurring in reactor operations during 1966 to 1968 are reviewed. A description of each incident and the resulting damage to the facility is included. Corrective actions taken for each incident are also described. NSA

N70-19875# Oak Ridge National Lab., Tenn. Operations Div.
PROBLEMS WITH THE HFIR CONTROL ROD DRIVES AND THEIR SOLUTIONS
A. P. Fraas and A. A. Abbatiello Nov. 1969 161 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2505) Avail: CFSTI

The only serious difficulties encountered in nearly three years of shakedown and operating experience with the HFIR have involved elements of the control drive mechanism. These difficulties have stemmed from a classical case of the subtle interaction of complex phenomena in ways that proved difficult to observe although their effects were obvious, that is, broken bearing support lugs and worm bearings. The symptoms observed, the analyses and tests conducted in the course of the diagnosis, and the changes made to solve the problems are described. Author

N70-19879# Oak Ridge National Lab., Tenn.
ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM Bimonthly Report, Sep.–Oct. 1969
Wm. B. Cottrell Jan. 1969 156 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2425) Avail: CFSTI

Considered is the removal of hazardous aerosols after accidental fission product release as well as the mechanical properties of various reactor materials and their ability to withstand corrosion induced failure. Membrane filters and spray solutions are considered as safety measures in coolant loss accidents. The operation of a nuclear safety information center is advocated. G.G.

N70-19898# Atomics International, Canoga Park, Calif.
EFFECT ON FAST BREEDER REACTOR CALCULATIONS OF USING REGION-DEPENDENT MULTIGROUP CROSS-SECTIONS
F. L. Fillmore 15 Sep. 1969 43 p refs
(Contract AT(04-3)-701)
(AI-AEC-12843) Avail: CFSTI

A procedure is described for obtaining a more appropriate ultrafine group weighting spectrum for each region than the fundamental mode spectrum. The code development is described which enables the entire calculation for an assembly to be run as a four-step job in the IBM/360-50 system. Calculations were made for three fast critical assemblies and for a model of a 500-MW(e) fast breeder reactor. For some cases the use of region-dependent weighting spectra produced a significant effect on the median flux energy in a region, but in none of the calculations did these changes result in significant effects on other calculated reactor parameters. Use of region-dependent weighting spectra in the generation of 5-group libraries for one of the assemblies made no improvement in the accuracy of the 5-group results, which were significantly different from 25-group results. It is concluded that the region-dependent weighting spectra method does not result in a significant improvement in reactor neutronic calculations. Author (NSA)

N70-19912 National Lending Library for Science and Technology, Boston Spa (England).
FUEL ELEMENT PROBLEMS ON THE STEAM COOLED FAST BREEDER
M. Fischer 2 Jan. 1970 11 p Transl. into ENGLISH from Atomwirtsch. Atomtech. (Duesseldorf), v. 14, no. 4, 1969 p 203–206
(NLL-Risley-Trans-1739-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Problems associated with loading, materials selection, and internally finned breeder fuel pins are described. The loading problems are identified as creep buckling caused by external pressure at high temperature, internal pressures present when the fission gas internal pressure is greater than the external steam pressure, and the thermal and mechanical stress changes in the normal operating cycle. Fuel can materials are discussed with respect to the creep buckling and corrosion problems. Technical and economic factors of steam breeder reactors, and the influence of fuel pins on breeding rate, fuel inventory, and economy are reviewed. N.E.N.

N70-19932# Argonne National Lab., Idaho Falls, Idaho.
A VERTICAL ASSEMBLER-DISMANTLER FOR THE FUEL CYCLE FACILITY
W. L. Sales, D. L. Mitchell, J. R. White, and J. P. Simon (Natl. Accelerator Lab.) [1969] 21 p refs Presented at 17th Conf. on Remote Systems Technol., San Francisco, 30 Nov.–4 Dec., 1969; Sponsored by Am. Nucl. Soc. *Its* Serial No. 17-26
(Contract W-31-109-eng-38)
(CONF-691102-1) Avail: CFSTI

A change in the program of Experimental Breeder Reactor (EBR-II) from a power demonstration reactor to a fast-flux irradiation facility necessitated a corresponding change in the capabilities of the adjoining Fuel Cycle Facility for handling irradiated subassemblies. A new Vertical Assembler-Dismantler (VAD) capable of handling experimental capsules was designed, constructed, and installed in the FCF Air Cell to replace existing driver-fuel assembly and disassembly equipment. This new machine was remotely installed with a minimum of interuption of normal cell activities. Performance of the new machine has met all design requirements adequately. Author (NSA)

N70-19934# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1969
27 Oct. 1969 141 p refs
(Contract W-31-109-eng-38)
(ANL-7618) Avail: CFSTI

Highlights of project activities are summarized for the month of September 1969. Fuel and components development programs for the LMFBR are described. LMFBR physics measurements and ZPR-3, ZPR-6, ZPR-9, and ZPPR operations during September are reviewed. Research and development programs in the EBR-2 are described. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. NSA

N70-19937# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DESIGN SURVEY AND CONCEPTUAL DEFINITION OF A REACTIVITY OSCILLATOR FOR THE FAST TEST REACTOR
P. K. Telford Oct. 1969 37 p refs
(Contract AT(45-1)-1830)
(BNWL-1036) Avail: CFSTI

A survey was completed of reactivity oscillators that have been designed for various nuclear reactors. The experience accumulated by each design was reviewed. Previously successful, specific design features or choices were selected and recommended for initial guidance to the designer of an oscillator for the fast test reactor. A conceptual definition embodying the selected design choices was generated. Author (NSA)

N70-19944# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SEALING MECHANISMS FOR FFTF CLOSED LOOP AND OPEN TEST POSITION CLOSURES
R. Kolowith Oct. 1969 85 p refs
(Contract AT(45-1)-1830)
(BNWL-1069) Avail: CFSTI

A state-of-technology survey of existing static mechanical sealing mechanisms was conducted to determine applicability to the Fast Flux Test Facility (FFTF) closed loops and open test position top face piping. Particular attention was directed to the 1200 F liquid Na environment, the remote make-and-break requirement, and the extremely compact space envelope typical of the closed loop reactor nozzle closure application. In the Fast Test Reactor (FTR) there are a variety of locations which must have seals capable of withstanding different but severe environmental conditions. Because of the high temperature Na and radiation environments, only metal-to-metal seals were surveyed. The survey was also limited to devices that have had some association with liquid metal, high temperature gas, or remotely operable environments. Brief descriptions of most of the mechanical sealing concepts that were used and/or tested in some or all of the more critical environments common to FFTF are presented. A list of candidate mechanical static sealing mechanisms was recommended for a prototypical development program. Author (NSA)

N70-19947# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
AUTOMATION OF EXPERIMENTAL COMPLEX DEVICES IN A NUCLEAR REACTOR [AUTOMATISATION DE DISPOSITIF EXPERIMENTAUX COMPLEXES DANS UN REACTEUR NUCLEAIRE]
M. Guerin and M. Grevaz 25 Apr. 1969 16 p In FRENCH Presented at Meeting on Automation in Nucl. Res. and Ind., Grenoble, France, 24–27 Jun. 1969
(CEA-CONF-1317; CONF-690626-1) Avail: CFSTI

A complex computer-based system for data acquisition and processing which was installed in the SILOE reactor is described. The system monitors the experiments, in-core radiation doses, evaluates safety system parameters, and continuously evaluates reactor operating data. The general organization and functioning of the programs for data acquisition and processing are summarized. NSA

N70-19955# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
FABRICATION OF PLUTONIA-URANIA PELLET, SHARD, AND SPHERE IRRADIATION SPECIMENS
L. J. Ferrell Sep. 1969 26 p refs
(Contract AT(30-1)-3714)
(BAW-3714-11) Avail: CFSTI

As part of the Gel-Addition program, an irradiations testing subtask was established to evaluate the effects of heat rate and time on the restructuring characteristics of sol-gel UO2-PuO2 spheres and angular particles prepared from coprecipitated UO2-PuO2. The techniques and procedures described were used to fabricate the fuel pins for those tests. Thirty-one fuel pins were fabricated; they were divided into groups of 12 angular-particle pins, 7 sphere pins, and 12 pellet pins. The pellet pins were for a reference pin in each capsule. The fuel used in these pins consisted of UO2-20 wt % PuO2. In approximately half of the pins the UO2 was enriched to 20 wt % U-235. The fuel smear density on all as-fabricated pins was in the range of 82 % theoretical density. Author (NSA)

N70-19961# Atomics International, Canoga Park, Calif.
FUELS, MATERIALS, AND COOLANT CHEMISTRY PROGRAMS Quarterly Technical Progress Report, Jan. – Mar. 1969
Mar. 1969 97 p
(Contract AT(04-3)-701)
(AI-AEC-12817) Avail: CFSTI

Research progress on fuel and cladding materials is reported in sections devoted to tasks associated with materials management, the effects and failure mechanisms, mechanical properties in static and dynamic Na, mixed carbide properties, and radiation effects, Na chemistry, and chemistry of fission product-contaminated Na. NSA

N70-19986# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
FISSION PRODUCT INVENTORIES. PART 2: RESULTS FOR MAGNOX, AGR, HTR, AND CFR REACTORS USING FISP
R. H. Clarke and R. E. Utting Jul. 1969 50 p refs
(RD/B/N-1428) Avail: CFSTI

The program FISP was used to obtain fission product inventories for Magnox, AGR, HTR, and CFR reactors. The use of the program for these specific applications is described in detail, so that the integrity of the results may be judged together with the effects of changes in basic data. Examples of complete inventories, given for illustration, were chosen for their general usefulness in a wide range of problems. They are representative of the more highly irradiated fuels from the four reactor types, and the basic burnup parameters are: Magnox 7,000 MWD/te at 5 MW/te; AGR 25,000 MWD/te at 20 MW/te; HTR 60,000 MWD/te at 50 MW/te; and CFR 100,000 MWD/te at 300 MW/te. Author (NSA)

N70-20016# Sandia Corp., Albuquerque, N.Mex.
SNAP-27 SHOCK OVERPRESSURE TEST (SHOCK TUBE FACILITY)
R. E. Berry Jul. 1969 124 p refs Sponsored by AEC
(SC-DR-69-65) Avail: CFSTI

The SNAP 27 was subjected to an explosive shock tube test simulating the shock overpressure resulting from a near maximum explosive abort of the S 4 stage of the Saturn V launch vehicle. This test demonstrated that the beryllium secondary thermal shield and fuel capsule assembly can withstand the simulated environment without fuel release. Author (NSA)

N70-20027# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MAYPACK BEHAVIOR IN THE CONTAINMENT SYSTEMS EXPERIMENT: A PENETRATING ANALYSIS
J. D. Mc Cormack Aug. 1969 44 p refs
(Contract AT(45-1)-1830)
(BNWL-1145) Avail: CFSTI

The Containment Systems Experiment sampling system is discussed briefly. This system uses Maypacks to sample the simulated fission products which are airborne during tests to study loss-of-coolant type of reactor accidents. The Maypack consists of a particle filter, silver screens, charcoal paper, and a charcoal bed, in order of flow. The characteristics of the Maypacks to retain and differentiate between the various forms of iodine and particulate materials are reported in detail. It is concluded that Maypacks can form the basis of a satisfactory sampling system, that the total airborne material is well retained in a properly used Maypack, that useful discrimination of iodine forms can be obtained, but that corrections are necessary at low inlet iodine concentrations, and that some ionic forms are not uniquely identified. Author (NSA)

N70-20028# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ESTIMATE OF THE FATIGUE CRACKING BEHAVIOR OF THE FAST TEST REACTOR PRIMARY PIPING
Earl B. Schwenk and Lee A. James Oct. 1969 89 p refs
(Contract AT(45-1)-1830)
(BNWL-1035) Avail: CFSTI

The concepts of linear elastic fracture mechanics are applied to the FTR primary piping. Estimates are made of fatigue crack propagation behavior for service conditions, and crack length versus cycles information is established. Author (NSA)

N70-20029# Argonne National Lab., Ill. Reactor Physics Div.
WEIGHTED-RESIDUAL METHODS IN SPACE-DEPENDENT REACTOR DYNAMICS
Edward L. Fuller, III (Ph.D. Thesis-Arizona Univ., Tucson) Apr. 1969 100 p refs
(Contract W-31-109-eng-38)
(ANL-7565) Avail: CFSTI

A study of approximate methods for the solution of problems in space-dependent nuclear-reactor dynamics is presented. It is shown that these approximate methods can all be thought of as applications of the method of weighted residuals. In each method, a trial solution is formed for the neutron flux. The trial solutions are expansions in known spatially dependent functions called trial functions. Each approximate method differs from the others in the manner in which its trial functions are chosen. The undetermined time-dependent functions, called amplitude functions, are then found by using the weighted-residual procedure known as the method of undetermined functions to derive the so-called multimode kinetics equations, which are first-order, ordinary differential equations in time. The multimode kinetics equations are then integrated using the method of undetermined parameters. Author (NSA)

N70-20034# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
VERIFICATION OF THE URANIUM AND PLUTONIUM MEASUREMENTS ON A BATCH OF DISSOLVED REACTOR FUEL
H. H. Ph. Moeken and H. Bokelund Jun. 1969 19 p refs
(NP-18021; ETR-235) Avail: CFSTI

Empirical equations are presented which describe the U depletion and the Pu build-up in irradiated reactor fuel as functions

of the U and Pu isotopic composition. The relationships are valid for fuel exposed in nuclear reactors using highly enriched, natural or slightly enriched U. The application of these equations for the independent verification of the measurements of the U and Pu concentration and isotopic composition, performed on dissolved batches of spent fuel is described. An estimate is given of the Np-237 production in highly enriched U. Author (NSA)

N70-20050# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.

A 1000-MWe LMFBR FOLLOW-ON STUDY. TASK 5: SAFETY STUDIES

R. G. Cockrell comp. Dec. 1968 131 p Prepared for Argonne Natl. Lab.
(Contract W-31-109-eng-38)
(WARD-2000-84) Avail: CFSTI

Safety studies for design requirements of a 1000 MW(e) LMFBR are reviewed. Safety studies include the following topics: overall plant requirements; core protection and containment; nuclear and radiation controls; reliability and testability of protection systems; reactivity control; reactor coolant boundary; engineered safety features; and fuel and waste storage systems. NSA

N70-20051# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

HOMOGENEOUS CRITICAL ASSEMBLIES OF 2 AND 3 PERCENT ENRICHED URANIUM IN PARAFFIN

S. J. Raffety and J. T. Mihalczo 2 May 1969 52 p refs
(Contract W-7405-eng-26)
(Y-DR-14) Avail: CFSTI

A series of clean critical experiments were performed with homogeneous mixtures of finely divided U(2)F4 or U(3)F4 dispersed in parafin with H/U-235 atomic ratios varying from 133 to 972. The assemblies were constructed in rectangular geometry and minimum critical masses and volumes in cylindrical and spherical gepmetries were obtained from buckling conversions. The minimum critical spherical volumes of a U(2)F4-paraffin mixture when unreflected and reflected with an effectively infinite hydrogenous reflector are 199 and 138 liters, respectively, and the minimum critical U-236 masses are 7.5 and 5.4 kg, respectively. Cadmium ratios at the center of the critical assemblies were measured for gold, In-Al alloy, 10 wt % U(93)-Al alloy and U(93) metal foils. Transport theory calculations were made using various cross section sets. The results indicate that the resonance absorption cross sections for U-238 may be too large. Author (NSA)

N70-20095# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.

SODIUM-COOLED REACTORS: FAST CERAMIC REACTOR DEVELOPMENT PROGRAM Quarterly Report, May–Jul. 1969

Aug. 1969 126 p refs
(Contract AT(04-3)-189)
(GEAP-10028-31; QR-31) Avail: CFSTI

Analytical and experimental studies are reviewed which are directed toward the development of fast reactors employing ceramic fuels, with particular attention given to mixed plutonium-uranium oxide. Tasks reported include: (1) defected fuel behavior; (2) safety experimentation; (3) fuel properties and performance evaluation; (4) integral fast flux irradiations; (5) core neutronics, thermal hydraulics, and safety analysis; and (6) cladding development. D.L.G.

N70-20101# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

SAVANNAH RIVER LABORATORY ISOTOPIC POWER AND HEAT SOURCES. PART 1: COBALT-60 Quarterly Progress Report, Apr.-Jun. 1969

C. L. Angerman and C. P. Ross, comps. Aug. 1969 21 p refs
(Contract AT(07-2)-1)
(DP-1206-1) Avail: CFSTI

Techniques were established for fabricating wafers of CoO, (CoMg)O, and CoAl2O4 at > 85% of theoretical density, and for fabricating assemblies for irradiation of these wafers to high specific activity. Thermal expansion coefficients and oxidation properties of CoO and (Co,Mg)O were measured. Composition and properties of 44 superalloy encapsulating materials were evaluated. Destructive examination confirmed the satisfactory performance of an inactive Hastelloy X capsule at 1000 C for 10,000 hr. Radioactive capsules of Haynes 25, Inconel 600, and Hastealloy X reached their goal exposure of 5000 hr at 1000 C. Ten tungsten capsules were purchased for weld development and long-term compatibility tests with cobalt metal at approximately 1200 C. Inconel 702 was recommended as a possible core material for the WANL 30 kW(t) demonstration heat source because of its oxidation resistance and relatively high thermal conductivity compared with other superalloys. Author (NSA)

N70-20103# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.

HIGH-FLUX STATIONARY RESEARCH REACTORS AND THEIR PROSPECTS

S. M. Feinberg 1968 24 p refs In RUSSIAN
(IAE-1693) Avail: CFSTI

Successful operation of stationary research intermediate-neutron reactors with a thermal-neutron trap is described. The prospects of further enlargement of the neutron flux are discussed. A comparison is made with the design of a fast-neutron accelerator used as the source of an intensive field of thermal neutrons. Author (NSA)

N70-20111# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.

ANALYTICAL PROCEDURES AND APPLICATIONS OF FLUENCE DETERMINATIONS FROM EBR-2 FLUX WIRES

A. Withop, B. A. Hutchins, and G. C. Martin Jan. 1969 28 p refs
(Contract AT(04-3)-189)
(GEAP-5744) Avail: CFSTI

A detailed review is presented of the General Electric methods and data used in determining flux levels in the EBR-2 by use of flux-wire analysis. Comments are offered on the accuracies involved in these methods as compared to the methods employed by the Argonne National Laboratory. In addition, other measurements of fluence are analyed. Neutron energy ranges which can be best expected to show correlations with possible damage mechanisms are discussed with suggestions as to the best means of measuring the neutron fluxes over the energy ranges of interest. 6 references. Author (NSA)

N70-20121 National Lending Library for Science and Technology, Boston Spa (England).

THE URANIUM/THORIUM CYCLE PROGRAMME

22 Oct. 1969 7 p Transl. into ENGLISH from Comit. Naz. Energia Nucl. Notiziario (Rome), May 1968 p 64-67
(NLL-RISLEY-Trans-1783-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The plans to investigate the technical and economic possibilities of the U/Th cycle and to study the technology in reprocessing irradiated fuel and fuel element refabrication are briefly described. The fissile material recovered from the reprocessing of the second third of the Elk River core will be used to make driver charge elements of the Halden heavy water reactor. The possibility of reprocessing fuel elements from a prototype HTR reactor is mentioned, and the costs of the program are tabulated. N.E.N.

N70-20144# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Nuclear Science.

GROUP CONSTANT PREPARATION FOR THE ANALYSIS

OF FAST NEUTRON SPECTRA
Martin Becker [1969] 6 p refs Presented at the Seminar on Multigroup Cross Sect. Prepn.: Theory, Tech., and Computer Codes, Oak Ridge, Tenn., 1-3 Oct. 1969
(Contract AT(30-3)-328)
(RPI-328-167; CONF-691011-1) Avail: CFSTI

Work on the problem of group constant preparation for highly resolved fast neutron and fast reactor energy spectra is described. The goal of the work is to test the adequacy of nuclear data and the treatment of the data in the energy range of importance to the analysis of fast reactors. Some improvements to the MC(2) code for spectrum calculations are described. NSA

N70-20147# Atomic Energy Establishment, Winfrith (England).
MEASUREMENT OF RELATIVE CONVERSION RATIO AND FAST FISSION RATIO IN LOW ENRICHMENT OXIDE LATTICE
G. A. Barnett, C. B. Besant, M. F. Murphy, and W. H. Taylor Aug. 1969 38 p refs
(AEEW-R-648) Avail: CFSTI

The techniques for the measurements of the modified conversion ratio and the U-238 and U-235 fission ratio in current use for water moderated lattices have been reviewed in some detail. The modified conversion ratio is defined as U-238 capture/U-235 fission and has been determined relative to a thermal column measurement with a random uncertainty of better than + or - 0.5% in the mean of repeated observations in a particular fuel rod. Known systematic errors affecting the measurements were + or - 0.4% for fuels of up to 1.3% U-235 enrichment and + or - 0.7% for 3% enriched fuels. U-238 capture measurements were based on detecting the 106 keV gamma-ray in coincidence with the 104 keV x-ray which resulted from the decay of Np-239. An independent check was made on the Np-239 formation using a chemical separation technique. Results by the two techniques are compared and agreement is good being of a similar order of magnitude to the errors in the measurements. Author (NSA)

N70-20150# Argonne National Lab., Ill.
POSTIRRADIATION INSPECTION OF SUBASSEMBLIES DISCHARGED FROM RUNS 25 AND 26 IN EBR-II
R. R. Smith and D. L. Mitchell Mar. 1969 40 p refs Sponsored by AEC
(ANL-EBR-002) Avail: CFSTI

The effects of bowing forces generated by stainless steel reflector subassemblies on driver subassemblies were investigated by making a series of dimensional checks on driver subassemblies discharged at the ends of Runs 25 and 26 in EBR-II. Postirradiation measurements were made of straightness, twist, and changes in dimensions across the spacer pads of opposite flats of the hexagonal tube of the driver subassemblies. The results of measurements of subassemblies discharged from Run 25 indicated no perceptible change in straightness or twist. The results of dimensional checks across the spacer pads of opposite flats, however, indicated an average decrease of 0.001 in. per set of flats. Straightness and twist tests were not made of subassemblies discharged from Run 26. The results of dimensional checks across the spacer pads of opposite flats of these subassemblies indicated a net decrease of 0.001 in. per set of flats. Author (NSA)

N70-20152# Gulf General Atomic, San Diego, Calif.
THERMIONIC CRITICAL EXPERIMENT: DESCRIPTION AND SAFETY ANALYSIS
S. Cohen, R. Moore, J. Russell, and J. Young 17 Jul. 1969 103 p refs
(Contract AT(04-3)-167)
(GA-8091) Avail: CFSTI

A description of the site and design parameters of the facility are presented. The safety and interlock systems are described. Operating rules and emergency procedures are reviewed. Safety regulations are described. NSA

N70-20168# Oak Ridge National Lab., Tenn.
ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM Bimonthly Report, Jul.-Aug. 1969
Wm. B. Cottrell Nov. 1969 117 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2718) Avail: CFSTI

Much of the work summarized is in support of water-cooled power reactor technology, including LOFT and CSE programs, and reflects current safety problems, such as measurements of prompt fuel element failure phenomena and the efficacy of containment spray and pool suppression systems for fission product removal. Also included are studies on the release and behavior of accident-released fission products, as well as the removal of these fission products and aerosols from gas streams by filters and adsorbers. Several projects are also conducted in support of the high temperature gas-cooled reactor (HTGR) and LMFBR programs. Other major projects include studies of primary piping and steel pressure vessel technology. Experimental work relative to pressure vessel technology includes investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy section steel technology and nuclear piping, pumps, and valves. Several of the projects are directly related to the AEC's standards program which entails development of engineering safeguards and the establishment of codes and standards for government owned or sponsored reactor facilities. Author

N70-20185 Rensselaer Polytechnic Inst., Troy, N.Y.
ACOUSTIC INSTABILITIES IN A GASEOUS CORE NUCLEAR ROCKET
Harry Mc Neill (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-6470

A simplified and idealized physical model is considered in which the fission gas is initially uniform, stationary, infinite in the longitudinal direction and bounded by a neutron reflector. The constancy of neutron flux rather than power was taken as a condition for stability. A simple stability criterion was obtained in terms of the equilibrium values of the system. The effect of the neutron field on system stability is investigated. The results indicate that the neutron field has a strong damping effect which tends to compensate for the amplification due to the density dependent fission cross-section. An analytical model is developed which is useful in studying the dynamics of a cavity reactor system. The stability analysis is accomplished by using a numerical-graphical method consistent with the uncertainty in fuel opacity data. The dispersion equation for the plasma is derived and solutions for sound wave propagation in the plasma is obtained. Dissert. Abstr.

N70-20218# Argonne National Lab., Ill. Reactor Physics Div.
PRESSURE TRANDUCERS FOR TREAT SODIUM LOOPS
L. E. Robinson and R. T. Purviance Jun. 1969 14 p refs
(Contract W-7405-eng-38)
(ANL-7107) Avail: CFSTI

The fast reactor safety meltdown program on advanced fuels in high-temperature Na required the development of specialized instrumentation to measure transient pressure. Conventional, commercially available strainbridge pressure transducers were successfully adapted to in-pile pressure measurement on high-temperature Na-filled loops, through the use of NaK liquid-column isolation technique. Developmental testing of the transduction system included steady-state and dynamic tests with a shock tube and a Mark-1 integral Na loop. Author (NSA)

N70-20223# Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM Semiannual Progress Report, Period Ending 31 Mar. 1969
Ann W. Savolainen, ed. Oct. 1969 245 p refs
(Contract W-7405-eng-26)
(ORNL-4424) Avail: CFSTI

Activities concerning the development of gas-cooled power reactors are reported. The principal effort has been in the areas of: (1) high-temperature gas-cooled reactor fuel element development and evaluation, (2) gas-cooled fast reactor fuel irradiation testing and (3) prestressed concrete pressure vessel development. A separate abstract was prepared for each of the three sections presented. NSA

N70-20226 Pennsylvania State Univ., University Park.
THE THERMAL CELL CONTRIBUTION TO THE PROMPT NEGATIVE TEMPERATURE COEFFICIENT OF REACTIVITY OF THE PENN STATE TRIGA REACTOR
Leo John Hoover (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-5557

The contribution of the thermal cell coefficient to the prompt negative temperature coefficient to reactivity of a TRIGA Mark III reactor was calculated over the temperature range from 23 to 427 C. The neutron energy range 0.001 to 1.0 eV was employed in a Monte Carlo program which treated the cell geometry and the neutron interactions as exactly as is presently possible. Averaging, splitting, and correlated sampling were utilized as variance reduction techniques. The correlated sampling was accomplished through the use of Richtmeyer numbers, which reduced the computation time by factors ranging from 2 to 25. The results show that the predominant effect leading to the prompt negative temperature coefficient has increased absorptions in the stainless steel cladding. Dissert. Abstr.

N70-20240# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1969
Robert B. Duffield and Stephen Lawroski 26 Sep. 1969 134 p refs
(Contract W-31-109-eng-38)
(ANL-7606) Avail: CFSTI

Highlights of project activities are summarized. Fuel and components development programs for the LMFBR are described. LMFBR physics measurements and ZPR-3, ZPR-6, ZPR-9, and ZPPR operations are reviewed. Research and development programs in the EBR-2 are described. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. NSA

N70-20274*# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT Quarterly Technical Report
15 Dec. 1969 132 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952536)
(NASA-CR-108784; Rept-IJ86-TOPS-480) Avail: CFSTI CSCL 18 N

Covered is the analysis of requirements and the detailed circuit design phase of the power conditioning electronics for a nuclear powered outer planet scientific spacecraft with a twelve year life. A study was completed to identify an optimum frequency range for operation of electronic power processors, and a comparison was made of three candidate electrical power distribution configurations. The electrical design of a two phase inverter, a quad redundant shunt regulator, a DC to DC converter, and typical power switching circuit was advanced and detailed schematics are presented. Additionally, the electronic piece parts of the front end of a Jensen oscillator were packaged utilizing thick film microcircuit techniques for improvement. The objective was a design to provide regulated power for engineering and science subsystems from a radioisotope thermoelectric generator, and to perform switching and control functions for the effective management and distribution of electrical power. The baseline electrical power subsystem established provides an optimized design to match the power source with the electrical loads, and also provides Peltier cooling at all times to extend thermocouple life. Author

N70-20278*# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
THERMIONIC SPACECRAFT DESIGN STUDY Phase 1 Report, 4 Feb. 1969-4 Jan. 1970
20 Jan. 1970 451 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952381)
(NASA-CR-108893; GESP-7031) Avail: CFSTI CSCL 22B

This topical report presents the work from the first phase of a design study of nuclear-electric propelled unmanned spacecraft. The electric power source is incore thermionic reactors based on either the flashlight or externally fueled diode concept. The study guidelines and approach are defined, and the characteristics of the candidate launch vehicles, thruster subsystem, and the payload and communications subsystem are presented. These areas are common to all candidate thermionic reactors. The definition of two spacecraft/ power plant configurations are presented which deliver 270 kWe power to the power conditioning units. This definition, presented for both the flashlight and externally fueled reactors includes the key items of spacecraft arrangement and a detailed weight breakdown. Power conditioning, heat rejection subsystem, shielding and spacecraft structure are detailed. The results show about a 20 lb/kWe weight advantage for the spacecraft based on the externally fueled reactor. The computer code employed in the spacecraft weight optimization is discussed, and some preliminary discussion of key mission operations is presented. Author

N70-20293# Institutt for Atomenergi, Halden (Norway).
OPERATIONAL EXPERIENCE WITH FAILED FUEL ASSEMBLIES AT HBWR
Ulf Ottersen Mar. 1969 26 p refs Presented at the Enlarged Halden Programme Group Meeting, Roeros, 11-14 Mar. 1969
(HPR-108; CONF-690323-1) Avail: AEC Depository Libraries

Radioactivity levels released to the surroundings were measured and compared to the limitations based on international recommendations. The release of active nuclides to the moderator, their distribution, and reduction are discussed. System contamination, active handling, and personnel exposure and control are touched upon, and it is shown that the problems are more limiting from an operational point of view than releases to the surroundings. Author (NSA)

N70-20308# Gulf General Atomic, San Diego, Calif.
FAST REACTOR SPECTRUM MEASUREMENTS Quarterly Progress Report, Period Ending 31 Jul. 1969
J. C. Young, P. d'Oultremont, K. Creutz, and J. M. Neill 15 Aug. 1969 31 p refs
(Contract AT(04-3)-167)
(GA-9669) Avail: CFSTI

The progress report for this period is presented. Included are: neutron spectra analysis in STSF-3 and STSF-4(E/T), neutron spectra in iron reflector, gamma ray pulse high spectra after intense neutron burst, neutron spectra form high power targets, and fast neutron spectra in subcritical assemblies. NSA

N70-20310# Oak Ridge National Lab., Tenn.
THE DEVELOPMENT OF A SPECTROMETER AND THE MEASUREMENT OF THE NEUTRON SPECTRUM FROM THE HEALTH PHYSICS RESEARCH REACTOR BETWEEN 90 keV AND 450 keV
D. R. Stone, J. H. Thorngate, K. W. Crase, M. D. Brown, and D.

W. Carver Nov. 1969 39 p refs
(Contract S-7405-eng-26)
(ORNL-TM-2707) Avail: CFSTI

A proton recoil telescope neutron spectrometer was developed to measure neutrons having energies between 50 keV and 450 keV. The proton radiator was a 17 micrograms/sq cm thick anthracene film separated a distance of 83.82 cm from a ZnS scintillation detector. A magentic analyzer was used between the radiator and detector to determine the momentum of the recoiling protons. The ORNL 3 MeV Van de Graaff accelerator was used to obtain the detector response as a function of proton energy, and the DOSAR Low Energy Accelerator was used to calibrate the magnetic field of the spectrometer. Spectral measurements of neutrons with energies between 50 keV and 450 keV were made 50 cm from the Health Physics Research Reactor. The results agreed well with a portion of measurements made previously with Li-6 spectrometer, but the agreement with a calculated form of the Godiva 2 spectrum for this energy region was not as good. Author (NSA)

N70-20322# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
THE EFFECT OF REACTOR GAMMA EMISSION ON THE RADIATION ANNEALING OF DEFECTS [VLIYANIE REAKTORNOGO GAMMA-IZLUCHENIYA NA RADIATSIONNYJ OTZHIG DEFEKTOV]
V. I. Karpukhin and O. K. Chugunov 1968 38 p refs In RUSSIAN
(IAE-1649) Avail: CFSTI

Experimental data are presented that indicate an increase in the effectiveness of radiation annealing of defects when the temperature of irradiation is elevated. This result is caused mainly by reactor gamma radiation. A qualitative calculation is given for the rate of formation of defects due to neutron and gamma radiation. Also presented are the results of calculation of the flux of Compton electrons producing an internal bombardment of the substance in an MR-2 reactor. Author (NSA)

N70-20337# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MASS-SEPARATOR IN THE APPARATUS JASNAPP
G. Muziol, V. I. Raiko, and Kh. Tyrroff 1969 31 p refs In RUSSIAN
(JINR-P6-4487) Avail: CFSTI

A short description of the designed apparatus for spectroscopic investigation of short-lived isotopes in the proton beam of the JINR synchrocyclotron is presented. The apparatus consists of chemical equipment for separation of the elements, electromagnetic mass-separator, and a device for extraction of enriched isotopes from the collector. An expected value of the isotope activity on the collector is estimated and the different factors, this value depends on, are considered. Author (NSA)

N70-20349 National Lending Library for Science and Technology, Boston Spa (England).
LEAK TESTING OF CONTAINERS AND CAPSULES FOR RADIO-ACTIVE MATERIALS
H. Kowalewsky et al 17 Dec. 1969 8 p Transl. into ENGLISH from Material Pruefung: (Duesseldorf), v. 11, no. 10, 1969 p 345 -347
(NLL-RISLEY-Trans-1865-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Safety regulations governing the transportation of radioactive materials are discussed along with special leakage tests for packages and capsules for high activity materials and nuclear fuels. Pressure rise, helium leak, and radioactive dip tests are described and compared for efficiency in the determination of possible leaks. Results indicate that the helium leak test is by far the most accurate process. J.M.C.

N70-20372*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Nuclear Power Sources Group.
ACTIVITIES OF THE RTG RADIATION TEST LABORATORY Progress Report, 1 Jul.-31 Dec. 1969
R. W. Campbell, M. A. Dore, and M. Reier Jan. 1970 26 p refs
(Contract NAS7-100)
(JPL-701-39; EM-342-101) Avail: CFSTI CSCL 18N

The safety analysis report for the RTG radiation test lab receipt of SNAP-19 or 27 fuel capsule assemblies was written and has received JPL approval. The gamma-ray spectrum from a SNAP-27 fuel capsule assembly was measured with both a calibrated Ge(Li) solid state spectrometer and with a 3 in x 3 in NaI(Tl) scintillation spectrometer. Data analysis was completed for the gamma-ray spectrum measurements of a SNAP-15A heat source using a Ge(Li) spectrometer. This has lead to a new technique for determining Pu-236 impurity concentrations. Author

N70-20375# Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt.
HBWR Quarterly Progress Report, Apr.- Jun.1969
Aug. 1969 123 p refs
(HPR-112) Avail: CFSTI

Heavy boiling water reactor operations and research activities are reviewed. Tasks include fuel irradiation, on-line digital computer control, in-core instrumentation development, and water chemistry. E.C.

N70-20397 Virginia Univ., Charlottesville.
DETERMINATION OF THE TEMPERATURE COEFFICIENTS OF REACTIVITY OF A REACTOR BY ANALYSIS OF ITS RESPONSE TO A RAMP INPUT
Ricardo deJesus Palabrica (Ph.D. Thesis) 1968 222 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-18227

A ramp input technique was developed, in which a linearly-varying input perturbs an initially critical reactor. The temperature coefficients are obtained from the resulting flux response and the knowledge of the reactivity insertion rate. The ramp input method permits measurement without necessitating access to the core or requiring any special equipment. The input reactivity is obtained by a mere withdrawal of a control rod which is already built into the system. The possibility of irregularities in the control rod motion is very remote, since the control rod is not alternately driven in and out of the core. In the analysis of the experimental flux response for the temperature coefficients, a mathematical model, where the coefficients are held as parameters, is set up for the reactor. The model is the integral form of the reactor kinetics equations. The values of the coefficients which make the theoretical response best fit the experimental results are taken as the values of the temperature coefficients of the reactor. Dissert. Abstr.

N70-20458# Gulf General Atomic, San Diego, Calif.
THE 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POST CONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM Quarterly Progress Report, Period Ending 31 Jul. 1969
29 Aug. 1969 41 p ref
(Contract AT(04-3)-314)
(GA-9494) Avail: CFSTI

Progress is reported on: (1) fission product distribution and release from gas cooled reactor fuel elements, (2) reactivity variations with core burnup and power variations, (3) content, decay, and buildup of xenon isotopes, (4) and cooling system and cladding of the Peach Bottom reactor. NSA

N70-20562# Atomic Power Development Associates, Inc., Detroit, Mich.
PRIMARY SODIUM SYSTEM PUMPS IN THE ENRICO FERMI ATOMIC POWER PLANT

T. P. Ross Jun. 1969 363 p refs
(Contract AT(11-1)-865)
(APDA-309) Avail: CFSTI

The development of the primary sodium system pumps at the Enrico Fermi Atomic Power Plant is described from concept stage through design, fabrication, testing, and operation in a nuclear plant. The influence of a developing design of a fast breeder reactor on the selection of a primary pump is discussed. Fabrication, erection, and water tests at the vendor's plant are also presented. Experience in preliminary and preoperational testing is presented, including an evaluation of the mechanical and hydraulic performance of the pump under normal and abnormal operating conditions. A detailed description of the pump, pump drives, and pump auxiliaries is included. The performance of the pump auxiliaries and their effect on pump operation are also presented. The operating and maintenance histories of the pump and auxiliaries are documented. Conclusions and recommendations for the design of future sodium pumps, based on experience with the primary sodium pumps, are summarized. Author (NSA)

N70-20596 National Lending Library for Science and Technology, Boston Spa (England).
CONTINUOUS TESTING IN THE MARCOULE PLANT
J. Chabert et al [1969] 6 p Transl. into ENGLISH from Bull. d'Inform. Sci. et Tech. (France), no. 140, Sep. 1969 p 23-26
(NLL-RISLEY-Trans-1866-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The continuous testing system of Marcoule chemical plant for irradiated fuel treatment is reviewed emphasizing the advantages of economy, safety, and regulation. Classical continuous testing of temperature, density, flow rate, and pH is evaluated, along with radio chemical measurements including alpha particles, gamma emission, and neutron irradiation. J.A.M.

N70-20607 National Lending Library for Science and Technology, Boston Spa (England).
HEATER RODS WITH INDIRECT RESISTANCE HEATING FOR SIMULATING NUCLEAR FUEL RODS
V. Casal 21 Nov. 1969 16 p refs Transl. into ENGLISH from Karlsruhe Nucl. Res. Centre Rept. KFK-894 (Germany), Mar. 1969
(NLL-RISLEY-Trans-1824-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Thermodynamic investigations of fuel elements for fast breeder reactors assume that the rods can be heated. Indirectly heated elements were developed, instrumented, and tested for this purpose. They have the dimensions of fuel rods of fast breeder reactors and withstand the reactor rod output at the required maximum temperature for the sheathing tubes. Tests of heat transfer and corrosion behavior were carried out under realistic operating conditions. Author

N70-20658*# Aerojet-General Corp., Azusa, Calif. Power Systems Dept.
DESIGN AND DEVELOPMENT OF A VOLTAGE REGULATOR-EXCITER FOR THE SNAP-8 NUCLEAR-ELECTRICAL POWER-CONVERSION SYSTEM
S. L. Bradley Oct. 1969 81 p refs
(Contract NAS5-417)
(NASA-CR-72645; AEROJET-3658) Avail: CFSTI CSCL 18N

A voltage regulator-exciter was developed for the 60 kw alternator used in the SNAP-8, Rankine-cycle, nuclear space power system. Performance and endurance tests were conducted and the test results indicated that the voltage regulator-exciter subsystem would provide reliable, voltage regulation performance exceeding the specification requirements for load changes of no load to full load. This report covers the design and tests conducted including test results obtained during the development of the voltage regulator. Author

N70-20782# Argonne National Lab., Ill. Chemical Engineering Div.
CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, MAY-DECEMBER 1968
Dec. 1968 118 p refs
(Contract W-31-109-eng-38)
(ANL-7550) Avail: CFSTI

Six program tasks are summarized: compact pyrochemical processes, fluoride volatility process, materials chemistry and thermodynamics, energy conversion, nuclear constants, and fluidized bed combustion of fossil fuels. Specific investigations discussed include: salt transport process for fast breeder reactor fuels; pyrochemical purification of plutonium-238, fluorination of simulated FBR fuels; penetration of fiber filters by PuO2F2 aerosol, chemistry of irradiated fast reactor fuels and materials, xenon tagging of fuel elements in EBR-2, calorimetry, chemistry of liquid metals, cells with lithium or sodium anodes, materials stability, monoenergetic cross section measurements, integral cross section measurements. E.C.

N70-20784# Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM Semiannual Progress Report, Period Ending 30 Sep. 1968
Ann W. Savolainen, ed. Mar. 1969 283 p refs
(Contract W-7405-eng-26)
(ORNL-4353) Avail: CFSTI

Information concerning the development of high-temperature gas-cooled reactors is presented. General topics discussed include: high-temperature gas-cooled reactor development; gas-cooled fast reactor development; and prestressed-concrete reactor pressure vessel research and development. NSA

N70-20795# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
USE OF CORRELATION METHODS FOR THE DETECTION OF LOCAL BOILING IN A LIGHT WATER REACTOR
Gilles Zwingelstein 20 Dec. 1968 8 p refs In FRENCH Presented at the Conf. on Appl. of Treat. of the Signal, Grenoble, 16 Dec. 1968
(CEA-CONF-1238; CONF-681211-1) Avail: AEC Depository Libraries

Methods of detection of in-core boiling in reactors and the Fourier transform methods for analysis of frequency characteristics are discussed. The experimental setup, using two detectors, for noise detection is described; the associated electronics and processing of signals are outlined. Results of noise measurements in the Siloette reactor are discussed briefly. Autocorrelation functions are shown for the cases of boiling and non-boiling. NSA

N70-20824# Kernforschungszentrum, Karlsruhe (West Germany). Inst. Fuer Angewandte Kernphysik.
CALCULATION OF HETEROGENEITY EFFECTS IN PERIODIC STRUCTURES OF THERMAL AND FAST NUCLEAR REACTORS
D. Wintzer Jan. 1969 48 p refs Transl. into ENGLISH from German Report no. KFK-743 Sponsored by USAEC/EURATOM Exchange Program
(EURFNR-613; KFK-743) Avail: CFSTI

A method is described to calculate heterogeneity effects with an acceptable calculation time, a uniform method, and few limiting assumptions as to the lattice cell geometry. The space and energy transport models in which the method was worked out are presented. The mathematical treatment yields a linear equation system for the emission density, for whose coefficients a uniform computer instruction is given. The physical significance of these coefficients (reaction coefficient) is discussed; the resonance problems boil down to its calculation. The use of self-shielding factors or group resonance integrals in calculating the reaction coefficients is described. The aim is to calculate the influence of the heterogenous

cell structure on the spectrum (averaged across the lattice cell), mean neutron lifetime, Doppler coefficients, void coefficients and reactivity of multizone reactors. Some application examples for fast and thermal reactors are included. Author (NSA)

N70-20829# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.
METHOD TO CALCULATE REACTIVITY WORTH BY INTEGRAL TRANSPORT THEORY
E. A. Fischer Jun. 1969 17 p refs
(EURFNR-681; KFK-995; EUR-4301) Avail: CFSTI

An integral transportation perturbation method is described for analyzing the reactivity worth of 2 zone assemblies. The assembly zones consist of the sample and the surrounding core. Comparisons with the first order perturbation method and experimental values are included. NSA

N70-20845# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
LMFBR/FFTF FUEL QUALITY CONTROL AND ASSURANCE ANALYTICAL CHEMISTRY PROGRAM, PHASE 2 Final Technical Report
D. H. Schmitt Sep. 1969 208 p refs
(Contract AT(30-1)-4088)
(BAW-4088-1) Avail: CFSTI

Sintered (U,Pu)O2 pellets and mixed oxide powder were analyzed. Results were obtained for the following measurements: uranium and plutonium assay, spectrographic impurities, O/M ratio, halogens, carbon, nitrogen, density, water content, homogeneity, and gas content. Author (NSA)

N70-20858 National Lending Library for Science and Technology, Boston Spa (England).
URANIUM ENRICHMENT AND GAS CENTRIFUGE
K. Tamai et al 22 Dec. 1969 24 p refs Transl. into ENGLISH from Shinku (Japanese), v. 12, no. 4, 1969 p 5-17 In JAPANESE and ENGLISH
(NLL-CA-Trans-227-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

The significance of uranium enrichment and problems involved are summarized. Various factors, such as a forecast of nuclear power generation which forms a background for uranium enrichment, are discussed. A simple introduction to the present situation of enriched-uranium production in the United States, and a simple introduction to an enrichment cascade are given. A centrifugal separation method, which seems hopeful for uranium enrichment in the future, and problems in research and development are described. The properties and methods of handling uranium hexafluoride are outlined. Author

N70-20859 National Lending Library for Science and Technology, Boston Spa (England).
USE OF CHEMICAL ANALYSIS IN DETERMINING BURN UP
F. Regnaud 17 Dec. 1969 9 p refs Transl. into ENGLISH from Bull. Inform. Sci. Tech. (Paris), No. 140, Sep. 1969 p 45-51
(NLL-DOUNREAY-Trans-448-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Principles in measuring the number of fissions and analytic methods are briefly described. The advantages and disadvantages are mentioned for two methods of determining fissile element depletion and the occurrence of a fission product. The analysis is carried out in two steps, and the facilities and methods are outlined. Mass spectrometry of highly active samples is done in shielded units, and of samples containing small quantities of radioactive elements in simply protected laboratories. N.E.N.

N70-20888# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.
EFFECTIVITY AND COST OPTIMIZATION OF SAFEGUARDS SYSTEM
R. Avenhaus and D. Gupta Mar. 1969 32 p refs
(KFK-906) Avail: AEC Depository Libraries

Two models for a safeguard system with flow measurement were studied on the basis of testing hypotheses for the amount of diverted fissile material. From the mathematical standpoint it is noted that these tests were adjusted only with respect to the costs which they themselves cause and not the losses (positive or negative) which they cause. One system is called the inspector's system in which the inspector can detect a diversion by observation and surveillance and the model is based on the theory of games. The other is a statistical model based on the flow measurements of fissile material at strategic points. The expressions developed for the probability of detection, error first and second kind, cost functions, and effectivity for the two systems are tabulated. NSA

N70-20890 National Lending Library for Science and Technology, Boston Spa (England).
ENRICHED URANIUM
22 Oct. 1969 7 p Transl. into ENGLISH from CEA Ann. Report (France), 1968 p 93-95 In ENGLISH and partly in FRENCH
(NLL-CA-Trans-224-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Improved operations at the gaseous diffusion plant resulted in direct precipitation of uranyl formiate from nitrate; this technique made it possible to prepare standard U308 doped oxides for emission spectrographic laboratories. Other developments reported were: (1) an improved model of cooling injection for the UF6/UF4 reduction reactor by hydrogen; (2) a decrease in pyrohydrolysis and reduction times in the UF6/UO2 fluidized bed transformation plant; (3) a new unit for producing metal ingots of 5 to 7 kg; etc. A general 25 percent improvement in isotopic separation performance was obtained by increasing the peripheral velocity of the gas ultracentrifuge. G.G.

N70-20918# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM, PART 3 Final Report
M. N. Baldwin and M. E. Stern Jul. 1969 47 p refs
(Contract AT(30-1)-3647)
(BAW-3647-13) Avail: CFSTI

The response of an all-solid self-powered in-core neutron flux detector was measured at temperatures approaching those of an operating power reactor. Measurements were made in a water environment and in a subcritical fueled lattice environment over a wide range of moderator boron concentrations. The results obtained are summarized. NSA

N70-20937# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
TEMPERATURE DISTRIBUTION AND THERMAL STABILITY IN ASYMMETRICAL TRIANGULAR ROD-CLUSTERS
M. Fischer and H. Shimamune Apr. 1969 51 p refs
(EURFNR-695; KFK-724; EUR-4178) Avail: CFSTI

A theoretical analysis is presented of fluid flow and heat transfer for axial turbulent flow in asymmetrical triangular rod-clusters caused by thermal bowing or fabrication inaccuracies. The method is applicable to calculate distribution of local shearing stress, coolant velocity, coolant temperature and local surface temperature. It can be used to predict the stability of bowed fuel rods and to decide the proper spacing of the supports. Numerical results are obtained for steam cooled fuels by eddy diffusivity and arc depth of bowing as parameters. Theoretical considerations are also applicable to sodium coolant. Author (NSA)

N70-20977# Kyoto Univ. (Japan). Research Reactor Inst.
REACTOR POWER MONITORING BY MEASURING N 16 AND N 17 ACTIVITIES IN PRIMARY COOLING WATER
Itsuro Kimura, Kozo Atobe, and Toshikazu [1969] 21 p refs In JAPANESE; partly in ENGLISH
(KURRI-TR-57) Avail: AEC Depository Libraries

In order to monitor power drift during long time operation of the Kyoto University Reactor, N-16 and N-17 in the primary cooling water have been measured with a small NaI(Tl) scintillation counter and a BF3 proportional counter. Proportionality between the conventional power meter, composed of a compensated ionization chamber and a micro micro ammeter, and the concentrations of N-16 and N-17 is satisfactory from 1 kW up to 5 MW full power, especially the accuracy for N-17 is less than 1%. Both N-16 and N-17 count rates during long time operation at high power level have shown no drift, although all control rods have remarkably moved. By pursuing N-16 and N-17 count rate after reactor scram, reactivity worth of control rods has been obtained and the result is relatively lower than the value which is measured by the positive period method. Also, the speed or the flow rate of primary cooling water has been measured with the N-16 and N-17 monitor.
Author (NSA)

N70-20980# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
CONSISTENT TREATMENT OF THE INFLUENCE OF THE NEW alpha-VALUE OF Pu 239 ON NUCLEAR SIZE WITH CONSIDERATION OF THE PLUTONIUM EQUILIBRIUM ISOTOPIC COMPOSITION [KONSISTENTE BEHANDLUNG DES EINFLUSSES DER NEUEN alpha-WERTE VON PU 239 AUF NUKLEARE KENNGROESSEN UNTER BERUECKSICHTIGUNG DER PLUTONIUM-GLEICHGEWICHTSISOTOPENZUSAMMENSETZUNG]
Edgar Kiefhaber Sep. 1968 7 p refs In GERMAN
(KFK-846; EUR-4152.d) Avail: AEC Depository Libraries

The equilibrium plutonium isotopic content (Pu sub infinity) is calculated for a steam cooled fast breeder reactor by means of the so-called null-dimensional model. Results of calculations of new Pu sub alpha values are compared with old values. Effects of Pu sub infinity on reactivity coefficients are evaluated for the steam cooled fast breeder; breeder efficiency is compared for old and new Pu sub alpha values.
NSA

N70-20981# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronphysik und Reaktortechnik.
CALCULATION OF DOPPLER COEFFICIENTS FOR FAST REACTORS [ZUR BERECHNUNG VON DOPPLERKOEFFIZIENTEN FUER SCHNELLE REAKTOREN]
Irmgard Siep Apr. 1969 61 p refs In GERMAN; ENGLISH summary
(KFK-983; EUR-4179.d) Avail: CFSTI

A complete documentation of the theoretical background of the Doppler Coefficient (DC) Program is given. The theory has been changed in some aspects compared to the formalism given in the original description. At various points of the derivation of the formulas, generalizations of the theory are proposed. Results of the DC-Program are compared with Doppler coefficients calculated by successive K calculation and perturbation theory. The different results are discussed.
Author (NSA)

N70-20982# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.
MELTING PHENOMENA IN UO2-IRRADIATED EXPERIMENT [SCHMELZPHAENOMENE IN UO2-BESTRAHLUNGSPROBEN]
D. Geithoff May 1969 27 p refs In GERMAN
(KFK-980; EUR-4177.d) Avail: CFSTI

In oxide fuel test samples partially melted under irradiation, the melt cavities and the ceramic structure were studied. Penetration by betatron-produced X-rays was used as the investigation method for the melt cavity. It was shown that the cavity form is dependent on the type and duration of irradiation. Typical forms for long-time, short-time, and cycle irradiations could be distinguished. The ceramographic determination of the melting limits in a fuel cross section was confirmed with the help of beta,gamma autoradiography and the cavity projection. Indications on the flow behavior of molten uranium dioxide could be obtained on the basis of ceramic ground sections.
Author (NSA)

N70-20983# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Heisse Chemie.
RECOVERY OF BY-PRODUCT ACTINIDES FROM POWER REACTOR FUELS
G. Koch May 1969 20 p refs Presented at Symp. on Transuranium Elem. Chem., Liege, 21 – 22 Apr. 1969
(KFK-976; Conf-690426-1) Avail: CFSTI

The amounts of Np, Am, and Cm produced in power reactors are discussed. Separation of these elements from spent fuels is considered and their behavior in the Purex Process investigated.
NSA

N70-20987# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
MODELS, METHODS, AND DIGITAL COMPUTER PROGRAMS FOR ANALYSES IN REACTOR DYNAMICS WITH EMPHASIS ON FAST BREEDER REACTORS AND COMPRESSIBLE SINGLE-PHASE COOLANTS
K. Hornyik Dec. 1968 111 p refs Sponsored by USAEC/EURATOM Exchange Program
(EURFNR-652; KFK-799; EUR-3964) Avail: CFSTI

The models used in describing the dynamic behavior of fast breeder reactors are described in detail. The thermohydraulic and neutronics models are discussed; applicable equations are given. The program computes, as needed, the: heat source distribution; heat flow and temperatures; coolant hydraulics; and neutron kinetics and feedback. The complete program is shown by a flow diagram; computations performed by each subroutine are listed. Input/output format is listed; error messages, storage requirements, and computing times are described. A sample problem is included. The program and subroutines are written in FORTRAN 4 and have been used on the IBM 7094 and 360/65.
NSA

N70-21002# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
DOPPLER FEEDBACK WITH DELAYED BRAKE TIME FOR SUPER-PROMPT CRITICAL EXCURSIONS IN FAST-BREEDER REACTORS [DOPPLERRUECKWIRKUNG MIT BREMSZEITVERZOEGERUNG BEI UEBERPROMPTKRITISCHEN EXKURSIONEN IN SCHNELLEN BRUTREAKTOREN]
W. H. Koehler Apr. 1969 16 p refs In GERMAN
(KFK-961) Avail: CFSTI

The equations which describe the time dependent processes which occur during superprompt critical reactivity transients are derived for the point kinetics and multigroup fast reactor models. An expression for the time dependent feedback is defined. Results of a numerical evaluation of 2 dollars are tabulated; these are compared with the results from the exact solution. Criteria for evaluating the safety of a fast reactor in terms of delay in feedback processes are proposed.
NSA

N70-21003# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorbauelemente.
THE INFLUENCE OF GEOMETRICALLY DEFINED COEFFICIENT OF ROUGHNESS ON HEAT TRANSFER AND PRESSURE DROP IN LENGTHWISE FLOW THROUGH A 7-ROD BUNDLE [DER EINFLUSS GEOMETRISCH DEFINIERTER RAUHIGKEITEN AUF WAERMEUEBERGANG

UND DRUCKABFALL IN LAENGS DURCHSTROEMTEN 7-STABBUENDELN]

V. Casal and R. Waggott Nov. 1968 66 p refs In GERMAN
(KFK-806; EUR-3966.d) Avail: CFSTI

The influence of a geometrically defined coefficient of roughness on heat transfer and pressure drop in lengthwise flow through a 7-rod bundle was studied. The results showed that roughness in the form of peripheral fins has a thermodynamic effect in spite of the slight increase of the spiral-like separator. The effects of the surface roughness on the thermodynamic and flow behavior of a flow in a 7-rod bundle agreed qualitatively with that previously determined for ring cleavage and quantitatively with bundle studies. By the application of fuel rods with various rod cross section, a considerable increase in heat transfer was attained with a moderate increase in pressure loss. The measurements showed that the chosen rod forms are still not optimum since the heat transfer increase decreased with increasing Reynolds number. The selected spacer—wire coils on the external rods—were not advantageous for the 7-rod bundle since they caused very non-uniform cooling. Author (NSA)

N70-21010# Kyoto Univ. (Japan). Research Reactor Inst.

RESEARCH ON RADIOACTIVE DUST IN THE AIR AT KUR OPERATION

Akihiko Negoro, Koichi Sekiya, Tsujimoto Hirotoshi, Yoshii Tadashi, Giichi Yoshii et al [1968] 6 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-56) Avail: AEC Depository Libraries

Investigations were carried out on the radioactive dust which might have been produced when KUR reactor operated. According to the results, the radioactive dusts produced in the course of operation of the KUR reactor may be divided into two kinds: the dust that may be originated from the fission production of the fuel; and the other, being the aerosols activated. The former, compared with the latter, is produced in greater quantity. Moreover, such a quantity appears to depend largely on the specific kind of fuel used and the time length of operation. Author (NSA)

N70-21021# Battelle Memorial Inst., Columbus, Ohio.

PROGRESS ON DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR ADVANCED REACTORS, JANUARY - MARCH 1969

Donald L. Keller Apr. 1969 101 p refs
(Contract W-7405-eng-92)
(BMI-1862) Avail: CFSTI

Progress is summarized on developments associated with sintering and vaporization of PUN and PUN-UN fuels, properties of the system UO2-U3N(3+x), compatibility of PUN-UN with cladding materials and reactor coolants, analysis of capsule-sodium bonds for O, fabrication of clad (U(0.8) Pu(0.2)N pellets, thermal irradiation of nitride fuels, EBR-2 fuel pin cladding, preparation of irradiation capsules, and preparation for PUN-UN fuel TREAT testing. Summaries are presented on research efforts devoted to determining effects of neutrons on stainless steel, effects of Ni on radioinduced high-temperature embrittlement of cladding, development of methods for determining radioinduced mechanical property changes in cladding, and effects of variables such as irradiation temperature, dose, and flux spectrum on mechanical properties of cladding. Research on high-temperature creep of fuels for liquid metal fast breeder reactors is described. Progress is reported on design and operation of in-pile creep capsules, fabrication of UO2 and PuO2-UO2 specimens for preirradiation creep testing, and on in-pile compressive creep testing. NSA

N70-21023# Oak Ridge Associated Universities, Tenn.

CONFERENCE ON SPECIAL TOPICS ON NUCLEAR EDUCATION AND RESEARCH

Apr. 1969 284 p refs Conf. held at Gatlinburg, Tenn., 28 - 30 Aug. 1967
(CONF-670846) Avail: CFSTI

Conference papers documented include discussions on radiation effects in solids; NASA direct energy conversion programs; direct energy conversion emphasizing nuclear radiation; fusion and plasma research; power reactor safety programs; space nuclear power systems; a reactor dynamics nuclear safety program; and nuclear education programs at various universities. E.C.

N70-21070# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.

METHOD OF EVALUATING PROGRESSIVE SUBSTITUTION EXPERIMENTS FOR THE DETERMINATION OF BUCKLINGS AND CRITICAL RADII

Friedrich Helm May 1969 41 p refs
(EURFNR-684; KFK-975; EUR-4175) Avail: CFSTI

It is shown that the variation in critical radius upon substitution of a new composition in a central zone of a reactor can be approximated by a three-parameter equation, one of the parameters being delta B sub r/B sub r the relative difference of the radial bucklings in the two reactor zones. A comparison with multigroup calculations shows the validity of the equations derived. Modifications are introduced which make them applicable for a considerable range of difference in the nuclear parameters of the two compositions. It is also shown that the presence of a reflector does not greatly interfere with the method. Finally an evaluation is given of three substitution experiments which were performed on the critical facilities SNEAK and MASURCA. Author (NSA)

N70-21080 National Lending Library for Science and Technology, Boston Spa (England).

DEVELOPMENT OF OXIDE SYSTEM FUELS

Yasuji Nakamura 17 Dec. 1969 22 p Transl. into ENGLISH from Genshi Ryoku Kogyo (Tokyo), v 14, no 8, 1968 p 19 - 24
(NLL-DOURREAY-TRANS-419-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The development of fast reactor mixed oxide fuels for use in Japan is reviewed, and the power output, and high temperatures of the fast reactor cores are discussed. It is shown that an overall heat generation of from 500 to 700 kw per 12 of reactor core occurs. The research and development accomplished since the work started are reported in the following areas: (1) requirements in development of manufacturing techniques, (2) manufacturing processes, (3) costs, (4) assembly design and erection, and (5) irradiation tests. A table comparing the manufacture of PuO2-UO2 pellet fuels by the co-precipitation method to the mechanical mixing method is included. F.O.S.

N70-21081# Battelle-Northwest, Richland, Wash.

REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Jan. - Mar. 1969

A. L. Bement, C. J. Dau, E. A. Evans, and R. E. Nightingale May 1969 260 p refs
(Contract AT(45-1)-1830)
(BNWL-1058) Avail: CFSTI

Summaries are presented on loop support activities, tube fabrication for in-pile use, instrument development, and heat exchanger fabrication. Progress is reported on nondestructive testing of nuclear materials. Research directed toward better definition of mechanisms and relations between burnup, temperature, pressure, and metallic structure of irradiated fissionable metals is summarized. Irradiation damage to reactor metals and fast reactor dosimetry experiments are discussed. Graphite studies are reviewed in association with fuel development for gas cooled reactors. NSA

N70-21082# Battelle Memorial Inst., Columbus, Ohio.

PROGRESS ON DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR ADVANCED REACTORS Annual Report, Jul. 1968 - Jun. 1969

Donald L. Keller Jul. 1969 242 p refs
(Contract W-7405-eng-92)
(BMI-1868) Avail: CFSTI

Progress is reported on development of uranium-plutonium nitride fuels, on radiation effects on cladding and structural materials, and on creep analysis of ceramic fuel elements for fast breeder reactors. NSA

N70-21100 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO THE DYNAMICS OF A NUCLEAR CLOSED-CYCLE GAS TURBINE PLANT WITH HIGH TEMPERATURE REACTOR
K. D. Kueper 17 Dec. 1969 20 p refs Transl. into ENGLISH from Proceedings of the IFAC Symp. on Multivariate Control Systems, Duesseldorf, 7 - 8 Oct. 1968
(NLL-WH-Trans-271-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A calculation model is described which was used to investigate the dynamic behavior of the nuclear power plant. Systems of equations are used to describe the plant operations and include models of the reactor, heat exchanger, and circuit. It is concluded that the plant can respond very quickly to changes in power requirements without essentially changing the reactor temperatures or the occurrence of instabilities in the circuit. D.L.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-19730# Boeing Co., Renton, Wash. Commercial Airplane Div.
GROUND EFFECT OF A PLANE UNIFORM SOUND SOURCE DISTRIBUTION
Sulmo Mariano 20 Jan. 1969 56 p refs
(D6-22600TN) Avail: CFSTI

A procedure is presented for finding a better approximation of ground effect in the measurements of noise generated by jet aircraft. This procedure is the result of taking a uniform plane distribution of sound sources instead of a single spherical source. The results of the procedure indicated above are a set of closed-form expressions corresponding to a pure tone receiver for the incoherent and coherent cases. These expressions represent far-field approximations. The incoherent case corresponds to a situation where the sound pressure generated by any source at the observation point is independent of the effects arisen from the other sources and the coherent case corresponds to a situation where the sound pressure generated by any source is in phase with the effects of the other sources. The procedure is suitable for the noise generated by compressors and fans where it can be assumed that the sound comes mainly from the inlet opening, specially at not too low frequencies. The special case when the normal to the plane containing sources is parallel to the ground was solved for a pure tone receiver. Some cases were solved numerically and plotted together with the solution given by the single spherical source in order to show the differences. Author

N70-19851# Joint Publications Research Service, Washington, D.C.
IMPROVING THE CONDITIONS OF LABOR IN THE MERCHANT FLEET NOISE CONTROL ON SEAGOING SHIPS
18 Dec. 1969 53 p refs Transl. into ENGLISH from Tr Tsentr. Nauch-Issled. Inst. Morsk. Flota (Leningrad), v. 14, no. 101, 1968 p 61-108
(JPRS-49472) Avail: CFSTI

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1. CALCULATING NOISE REDUCTION IN LARGE-DIAMETER LINED DUCTS F. Ye. Grigoryan p 1-12 refs (See N70-19852 08-23)
2. CALCULATING SELF-EXCITING GAS DYNAMIC OSCILLATIONS IN HEAT EXCHANGER GASLINES V. I. Zinchenko et al p 13-24 refs (See N70-19853 08-12)
3. NOISE REDUCTION IN SHIP AIR-CONDITIONING SYSTEMS A. G. Yelnik p 25-39 refs (See N70-19854 08-23)
4. MUTUAL SPECTRA METHODS V. I. Loshakov p 40-47 refs (See N70-19855 08-23)
5. SELECTIVE ANALYSIS OF NOISE FROM A COMPLEX SOURCE F. Ye. Grigoryan p 48-53 (See N70-19856 08-23)

N70-19852# Joint Publications Research Service, Washington, D.C.
CALCULATING NOISE REDUCTION IN LARGE-DIAMETER LINED DUCTS
F. Ye. Grigoryan *In its* Improving The Conditions of Labor in the Merchant Fleet Noise Control on Seagoing Ships 18 Dec. 1969 p 1-12 refs (See N70-19851 08-23)
Avail: CFSTI

Functions are derived for calculating the damping of high-frequency noise in the air intakes of gas turbine engines. Noise reduction in the ducts is dependent on the scattering of sound in the sound-absorbing lining. Geometric acoustics and statistical methods are combined to study the refraction and reflection of sound waves at the boundaries of the system being investigated. R.B.

N70-19854# Joint Publications Research Service, Washington, D.C.
NOISE REDUCTION IN SHIP AIR-CONDITIONING SYSTEMS
A. G. Yelnik *In its* Improving the Conditions of Labor in the Merchant Fleet Noise Control on Seagoing Ships 18 Dec. 1969 p 25-39 refs (See N70-19851 08-23)
Avail: CFSTI

The effect of air conditioning on the noise in ship compartments was tested on high pressure single- and two-duct systems on various diesel ships. It was found that one of the basic sources of noise is the terminal air distributors in which the noise intensity depends on the velocity of the air in the intake and the air distributor ducts, and on the shape of the latter. By acoustic calculation, the noise of elements in both the terminal air distributor and in the main system is reduced to allowable values. Noise in the terminal air distributors is reduced by decreasing the air velocity in the intake duct, in the air distributor ducts, and at the exhaust from the air distributor; by improving the aerodynamic characteristics of the air distributor; and by installing an effective muffler. R.B.

N70-19855# Joint Publications Research Service, Washington, D.C.
MUTUAL SPECTRA METHODS
V. I. Loshakov *In its* Improving the Conditions of Labor in the Merchant Fleet Noise Control on Seagoing Ships 18 Dec. 1969 p 40-47 refs (See N70-19851 08-23)
Avail: CFSTI

Equations are given from which functions can be derived for acoustic measurements by the reciprocal spectrum method. The instruments used for measuring the spectrum are described. R.B.

N70-19856# Joint Publications Research Service, Washington, D.C.
SELECTIVE ANALYSIS OF NOISE FROM A COMPLEX SOURCE
F. Ye. Grigoryan *In its* Improving the Conditions of Labor in the Merchant Fleet Noise Control on Seagoing Ships 18 Dec. 1969 p 48-53 (See N70-19851 08-23)
Avail: CFSTI

A selective method is described for measuring noise from a complex source by which any section of any periodic process can be separated in time, the oscillation intensity in individual sections of the cycle can be measured, and individual sections of the entire oscillatory process can be analyzed by frequency by choice of the experimeter. The selection of individual sections of the oscillatory cycle permits isolation of noise or vibrations caused by individual noise sources of machines. R.B.

N70-19881*# Boeing Co., Renton, Wash. Commercial Airplane Div.

OPTIMIZATION OF DUCT LININGS FOR SOUND ATTENUATION

Fred W. Fischer and A. O. Andersson [1968] 94 p refs
(Contract NAS1-7129)
(NASA-CR-108249; D6-29356-TN) Avail: CFSTI CSCL 20A

Expressions are derived from which noise attenuation in acoustically lined ducts with and without air flow can be calculated. All possible modes of sound propagation in ducts of various geometries have been considered. Numerical analysis has been carried out to a stage, from which computer programming can be performed. It is shown how the results can be used for the optimum design of inlet and fan duct linings for the reduction of fan noise from jet engines. Author

N70-20004# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THE EFFECT OF TWO-MAGNON SCATTERING ON PARALLEL-PUMP INSTABILITY THRESHOLDS Technical Report

Jay Peter Sage Jul. 1969 128 p refs
(Contract N00014-67-A-0298-0006)
(AD-698123; TR-594) Avail: CFSTI CSCL 20/12

Following a general description of the important properties and symmetries of the parallel-pump coupling and of two-magnon scattering, several theoretical approaches to the problem of the effect of two-magnon scattering on the parallel-pump instability threshold are explored. A successful approach, based on the rate of energy flow among the spinwave modes and involving only elementary mathematical tools, is developed. Extensive experimental data on the wave vector dependence of delta H sub k over a wide range of temperatures in ferromagnetic Cd Cr2 Se4 are also presented. Results of theoretical calculations at several temperatures are compared with these data, and interesting information about spinwave renormalization and the dominant multimagnon scattering mechanisms at temperatures up to about 90% of the Curie temperature is obtained. Author (TAB)

N70-20053# Raytheon Co., New London, Conn. Marine Research Lab

ACOUSTIC PROPAGATION IN A STRATIFIED MEDIUM Research Report

Frederick R. Di Napoli 13 Aug. 1969 91 p refs Prepared in cooperation with Rhode Island Univ.
(Contracts N00014-67-C-0241; N140(70024)-78298B)
(AD-697928; USL-1048) Avail: CFSTI CSCL 20/1

The solution for the acoustic field due to a monochromatic point source located in a stratified medium is obtained by direct numerical integration of the relevant hydrodynamical field equations. The application of the method is demonstrated via various examples and shown to provide accurate results. In order to implement the formalism, it is necessary to solve for the depth dependent Greens function associated with the reduced wave equation. Two general methods of solution are presented and discussed. The first is an exact representation in terms of hypergeometric functions. The second has its foundations in the theory of integral equations. Author (TAB)

N70-20138# Army Foreign Science and Technology Center, Washington, D.C.

FEASIBILITY OF APPLYING FIBER OPTICS IN LINEAR MEASUREMENTS BY TELEVISION METHODS

V. A. Rabinovich et al 23 Oct. 1969 11 p refs Transl. into ENGLISH from Optiko-Mekhanicheskaya Promyshlennost USSR, v. 35, no. 11, 1968 p 4-7
(AD-69808U; FSTC-HT-23-008-70) Avail: CFSTI CSCL 20/6

Some possibilities of applying fiber optics in linear measurements by television are investigated. An example is presented of constructing a digital optical system the basic element of which is a fiber-optical encoding device. Author (TAB)

N70-20153# Bettis Atomic Power Lab., Pittsburgh, Pa.

MANEL: A FORTRAN-4 DIGITAL COMPUTER PROGRAM TO SOLVE A RECTANGULAR MAGNETIC NETWORK

D. A. Guerdan (West Mifflin, Pa.) and O. J. Marlowe (West Mifflin, Pa.) Sep. 1969 25 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-790) Avail: CFSTI

The MANEL program provides a solution to the same magnetic network as did the MO585 (WAPD-TM-557) program. The revised mathematical formulation of the problem is described. Author (NSA)

N70-20191 Princeton Univ., N.J.

OPTICAL STUDY OF DOMAIN DYNAMICS IN GADOLINIUM IRON GARNET NEAR THE COMPENSATION TEMPERATURE

Thomas John Nelson (Ph.D. Thesis) 1968 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-2771

Gadolinium iron garnet has a magnetic compensation point near room temperature. It also exhibits Faraday rotation, which depends only on the magnetization of the iron sublattice. Therefore the Faraday rotation is undiminished at the compensation point, and it is possible to observe the domain structure in a continuous range of temperatures around the compensation temperature. The switching speed of gadolinium iron garnet single crystals is measured near the compensation temperature, as a function of applied field and sample temperature. The domain wall mobility and switching coefficient are calculated as a function of these parameters. The results are used to evaluate the suitability of compensated ferrimagnets for computer applications, and suggestions are made toward achieving practical computer devices. Dissert. Abstr.

N70-20258# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.

CALCULATION OF THE ELECTROMAGNETIC PARAMETERS OF MAGNETIC SYSTEMS WITH RIGHT-ANGLE COILS [RASCHET ELEKTROMAGNITNYKH PARAMETROV MAGNITNYKH SISTEMS PRYAMOUGOL'NYMI KATUSHKAM]

V. V. Breev, N. M. Kolydain, and V. P. Panchenko 1968 70 p refs In RUSSIAN
(IAE-1716) Avail: CFSTI

The calculation of electromagnetic parameters the (B/I ratio, inductance L, and ohmic resistance R) of magnetic systems is studied with reference to purposes of MHD energy conversion. A method of approximate analysis of those systems is presented. The main content of the paper is devoted to the elaboration of methods of numerical calculations of magnetic systems with rectangular coils. Typical results are presented of detailed calculations of the distribution of the magnetic field over the working volume and in the winding of a magnetic system, and an analysis is given of the influence of the geometric dimensions on the electromagnetic parameters. Corresponding tables were compiled for magnetic systems of various sizes. NSA

N70-20259# Oak Ridge National Lab., Tenn. Health Physics Div.
REVISED FORMULATION OF THE MACROSCOPIC MAXWELL THEORY. PART 1: FUNDAMENTALS OF THE PROPOSED FORMULATION
Jacob Neufeld Nov. 1969 33 p refs
(Contract W-7405-eng-26)
(ORN-4406-Pt-1) Avail: CFSTI

A modified version of the macroscopic Maxwell theory is developed with the purpose of removing some of the current contradictions and inconsistencies. One of the crucial problems of the current electromagnetic theory concerns the concept of energy. It appears that energy, which has a clearly defined physical significance in all fields of physics, has not been properly incorporated into the Maxwell-Lorentz theory. Therefore, the electromagnetic energy in a dissipative system as interpreted in the current version of the theory is not energy in the same sense as one usually interprets this concept in classical mechanics. The main object of this investigation is, therefore, to clarify the meaning of energy and to suggest a revised version in which the concept of energy is incorporated in accordance with the logical requirements of the theory. The proposed version is based on an assumption that the electrical energy both in nondissipative and dissipative media has a meaning only to the extent to which the electric-field theory can be developed as a theory of a dynamical system. Author (NSA)

N70-20260# Oak Ridge National Lab., Tenn. Health Physics Div.
REVISED FORMULATION OF THE MACROSCOPIC MAXWELL THEORY. PART 2: PROPAGATION OF AN ELECTROMAGNETIC DISTURBANCE IN DISPERSIVE MEDIA
Jacob Neufeld Nov. 1969 52 p refs
(Contract W-7405-eng-26)
(ORNL-4406-Pt-2) Avail: CFSTI

The theory of energy propagation in dispersive media formulated by Brillouin is generalized and extended by taking into account energy attentuation or energy growth during the transmission process. Because of the exponential decay due to attenuation, the concept of propagation velocity of an electromagnetic distrubance can now be shown to have a physical meaning, even if there is absorption, and in such case the velocity of the disturbance is represented by the velocity of the point at which it attains its maximum intensity. Expressions are obtained for the energy density and the energy flow in an absorbing medium, and it is shown that the propagation velocity (a kinematic concept) is equal to the velocity of the energy transport. Such an equality is considered to be of fundamental interest, since it supports the validity of the kinematic approach from the energetic point of view. Other aspects of energy transmission are discussed and analyzed, with particular references to nonconvective and convective disturbances in absorbing and emitting media. Author (NSA)

N70-20341# Sperry Rand Research Center, Sudbury, Mass.
MAGNETOELASTIC LOVE WAVES Final Report, 1 Oct. 1968 - 30 Sep. 1969
Herbert Matthews Nov. 1969 47 p refs
(Contract N00014-69-C-0027)
(AD-698193; SRRC-CR-69-22) Avail: CFSTI CSCL 20/3

The properties of Love waves are reviewed. A theoretical investigation of Love waves in magnetic substrates is discussed, and discovery of a unique non-reciprocal coupling between elastic and magnetostatic surface waves is described. Development of a thin-film surface-wave transducer of general utility at UHF frequencies is described. Author (TAB)

N70-20344 California Univ., Berkeley.
DIFFRACTION OF LIGHT BY ACOUSTIC SURFACE WAVES
Erich Peter Ippen (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-3618

The diffraction of light by acoustic surface waves is analyzed theoretically. Expressions are derived to predict the amplitudes of diffraction orders in both the transmitted and reflected spectra. Reflected diffraction results from a rippling of the acoustic surface; transmitted diffraction is due to the combination of surface ripple and subsurface strains. Optical heterodyne techniques for the detection of acoustically scattered light are described in detail. The results of experiments with surface waves in crystalline quartz are presented for comparison with theory. Specific measurements of surface-wave amplitude, velocity, and attenuation are reported. Experimental results illustrating acoustic standing-wave behavior and describing the simultaneous observation of bulk waves and surface waves are also included. Dissert. Abstr.

N70-20447 Purdue Univ., Lafayette, Ind.
ATTENUATION OF ULTRASONIC WAVES IN INDIUM ARSENIDE
Max Johann Keck (Ph.D. Thesis) 1968 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-7466

The attenuation of ultrasonic waves propagating in the (110) direction of InAs has been measured by means of the pulse-echo technique between 1.5 K and 300 K. At the lowest temperatures the measured attenuation is independent of temperature and its value is about 1db/cm at 210 MHz for all three types of waves. The difference between the attenuation measured at somewhat higher temperatures and this residual attenuation depends on temperature and frequency in a manner which can be explained by means of threephonon collision processes in which the sound wave phonon loses energy to transverse thermal phonons. Dissert. Abstr.

N70-20464*# Houston Univ., Tex. Dept. of Physics.
SPACE RELATED TECHNICAL INVESTIGATIONS Progress Report, 1 Mar. 1969-28 Feb. 1970
A. F. Hildebrandt Feb. 1970 22 p refs
(Grant NGR-44-005-022)
(NASA-CR-108900) Avail: CFSTI CSCL 20I

Theoretical considerations and initial experimental efforts on the detection of low energy neutral ions in plasmas and bremsstrahlung spectra emitted from a dense plasma focus mode of a plasma accelerator are discussed. Brief descriptions of efforts on atomic processes and solid state physics studies are also given, and include many body effects in metals, crystal response to external fields, quantum fluid interactions with physical boundaries, flux quantization and the vector potential in unipolar induction, and applications of exterior differential forms. N.E.N.

N70-20467*# Cornell Univ., Ithaca, N.Y. Center for Applied Mathematics.
A SURVEY OF SONIC BOOM THEORY
R. Seebass 19 June 1968 59 p refs Presented at the Ann. Aviation and Space Div. Conf. of the ASME, 19 Jun. 1968
(Grant NGL-33-010-054)
(NASA-CR-108898) Avail: CFSTI CSCL 20A

A basic theory of sonic booms for the case of steady flight in an atmosphere without winds is outlined. The mid-field region, centered about Mach waves in which the distance away from the Mach waves is small compared to the distance away from the aircraft, is considered of primary importance and is examined in detail. The theory is then extended to give the full pressure signature. Aerodynamic schemes for reducing the sonic boom are described, and the possibility of designing aircraft with overpressure signatures modified to reduce human annoyance is discussed. Expressions are also included for the minimum front shock pressure rise and the minimum overpressure level, for given aircraft and flight conditions. N.E.N.

N70-20475 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF SOUND WAVES ON THE FORM AND

SHIFT OF FAINT FRAUNHOFER LINES IN THE SOLAR PHOTOSPHERE [K VOPROSU O VLIYANII ZVUKOVYKH VOLN NA FORMU I SDVIG SLABYKH FRAUNGOFEROVYKH LINII V FOTOSFERE SOLNTSA]

B. T. Babii and A. D. Al'tman [1969] 9 p refs Transl. into ENGLISH from Soln. Dannye, (Russia), no. 5, 1969 p 103-109
(NLL-RTS-5569) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The problem of possible reasons for asymmetry and shift of photospheric Fraunhofer lines is discussed. It is shown that sound waves can have an important influence on the peculiarities of the profiles of these lines. Author

N70-20486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF INSTITUTIONS OF HIGHER LEARNING. RADIO PHYSICS: SELECTED ARTICLES

S. A. Akhmanov et al 31 Jan. 1969 38 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zavedenii Radiofiz. (Moscow), v. 10, no. 12, 1967 19 p
(AD-695011; FTD-HT-23-736-68) Avail: CFSTI CSCL 20/6

Contents: Aperture limitations on the efficiency of optical frequency doublers; and Evaluation of light depolarization by turbulent inhomogeneities of the atmosphere. TAB

N70-20589*# Avco Corp., Lowell, Mass. Applied Technology Div.

A STUDY OF THE COUPLING OF ACOUSTIC ENERGY FROM THE TROPOSPHERE TO THE IONOSPHERE Final Technical Report

David G. Detert 15 Feb. 1969 208 p refs
(Contract NAS8-20179)
(NASA-CR-102505 Avail: CFSTI CSCL 20A

This report describes the second twelve months of a continuing program of experimental measurements to investigate the possibility of coupling between ground level and ionospheric effects through the propagation of low frequency acoustic waves. The two tropospheric sources considered are the static firing of large rocket engines at NASA/MSFC and the occurrence of local thunderstorms. The observing system consists of a network of three, short-baseline, near vertical incidence of Doppler sounding paths near Huntsville, Alabama, each operating with three simultaneous transmission frequencies. The general operation of the experiment and the experimental findings relative to ionospheric dynamics phenomena caused by static test events and local meteorological disturbances are discussed. A three dimensional acoustic ray tracing computer program is briefly described, and a Fortran listing is given. Author

N70-20682 National Lending Library for Science and Technology, Boston Spa (England).

A NEW HIGHLY-EFFECTIVE SOUND-ABSORBING ASSEMBLY AND THE CONSTRUCTION OF AN ANECHOIC CHAMBER

E. Meyer et al 17 Dec. 1969 18 p Transl. into ENGLISH from Akustische Z. (German), v. 5, 1940 p 352-364
(NLL-RISLEY-Trans-1859-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Acoustic measurement studies deal with: (1) the conventional methods and materials used in the construction of anechoic chambers; (2) a determination of materials for an advanced sound absorbing assembly; (3) the construction of an anechoic chamber using proposed technologies and materials; and (4) the measurement of sound propagation in a damped room. D.L.G.

N70-20760*# National Scientific Labs., Inc., McLean, Va.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF ACOUSTIC POINT SOURCE RADIATION IN THE PRESENCE OF A REFLECTING AND REFRACTING PLANE Final Technical Report, Aug. 1968-Jul. 1969

John C. Corbin Aug. 1969 179 p refs
(Contract NAS8-21414)
(NASA-CR-102504) Avail: CFSTI CSCL 20A

The theoretical and experimental techniques applied to the problem of acoustic point source radiation in the presence of a reflecting and refracting half space are delineated. The study is concerned with the ultimate application of far field data to the study of the dynamic environment of rocket engines, in particular, those of the Saturn 5 launch vehicle. Author

N70-20815# Pennsylvania Univ., Philadelphia.

COHERENCE PROPERTIES OF ELECTROMAGNETIC FIELDS Final Report, Jun. 1965-Oct. 1969

Mark Beran Oct. 1969 15 p refs
(Contract DA-31-124-ARO-(D)-340)
(AD-697840) Avail: CFSTI CSCL 20/3

The purpose of this contract was to study a number of areas that require the use of higher-order coherence and correlation functions. Research was performed in the following areas: (1) Determination of the statistical properties of static electric and elastic fields in a random medium; (2) Study of the propagation of the second and fourth-order coherence functions in a random medium; (3) Quantum field formulation of the scattering of partially coherent radiation. Author (TAB)

N70-20950# Atomic Energy Commission, Washington, D.C.

LONG-WAVE PERTURBATIONS OF STELLARATOR MAGNETIC SYSTEM GEOMETRY

I. I. Danilkin 1968 40 p refs Transl. into ENGLISH from Russian report NP-17779
(AEC-tr-7069; NP-17779) Avail: CFSTI

Long-wave perturbations of geometric parameters in a stellarator magnetic system were studied so that the most critical geometric distortions might be revealed. Comparisons of effective amplitudes of these perturbations revealed, in particular, that geometric nonaxiality of the conducting systems producing longitudinal and helical fields belongs to the group of such critical perturbations. In such a case, the basic resonance in the preaxial region may induce shifting of the magnetic axis system of the aperture arrangement of a vacuum chamber, which in turn would demand precision adjustments or a special system for compensation of such possible field perturbations. Author (NSA)

N70-20998 National Lending Library for Science and Technology, Boston Spa (England).

THE COLOUR OF TOURMALINES AND THEIR INVESTIGATION IN ULTRAVIOLET POLARIZED LIGHT [OB OKRASKE TURMALINOV I IKH ISSLEDOVANII V ULTRAFIOLETOVOM POLYARIZOVANNOM SVETE]

S. V. Grum-Grzhimailo Dec. 1969 11 p refs Transl. into ENGLISH from Tr. Inst. Krist. Akad. Nauk SSSR (USSR), v. 12, 1956 p 79–84
(NLL-RTS-5346) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

Visible and ultraviolet absorption spectra were studied to classify colors of tourmalines and to determine their origin. It was found that the following colors were caused by ions in the six coordination: rose by trivalent manganese; yellow green, blue, and yellow by trivalent iron; green, green blue, and greenish brown by divalent iron; green gray and gray by divalent iron plus impurities; dark blue tips by divalent iron plus another ion, possible trivalent iron. The colorless tourmalines seem to contain iron not entering into the O-octahedra. Polarized ultraviolet light was used to determine the exact position of the colored zones. It is concluded that microphotography in polarized ultraviolet light and the spectral absorption of the samples over a wide wavelength band must be used to show the nature of isomorphous admixtures and their distribution in the crystal. N.E.N.

N70-21096# Pittsburgh Univ., Pa.
RESEARCH IN GRAVITATIONAL THEORY Final Technical Report
Erza T. Newman and Allen I. Janis Wright-Patterson AFB, Ohio ARL Jul. 1969 93 p refs
(Contracts F33615-67-C-1405; AF-33(615)-1523)
(AD-697394; ARL-69-0113) Avail: CFSTI CSCL 20/10

The report discusses work in four areas of research connected with general relativity: scattering of radiation and the existence of wave tails; conservation laws, with the major emphasis being on the conserved quantities discovered by Newman and Penrose; exact solutions of the Einstein and Einstein-scalar equations, with particular attention being paid to an analysis of event horizons in these solutions; and new approach to the study of equations of motion. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-19717# Brown Univ., Providence, R.I. Dept. of Physics.
BROKEN CHIRAL SYMMETRY AND THE VENEZIANO MODEL
Jeremiah A. Cronin and Kyungsik Kang [1969] 10 p refs Sponsored in part by AEC
(NYO-2262-TA-210) Avail: CFSTI

Chiral symmetry breaking within the K pion system is investigated when a Veneziano model is assumed for various off mass shell extrapolations. Expressions for the matrix elements of sigma terms and the divergence of the strangeness changing current are derived and the implications to chiral symmetry breaking interactions is discussed. Author (NSA)

N70-19723 Oregon State Univ., Corvallis.
A COMPARISON OF EFFECTIVE INTERACTIONS IN NUCLEAR STRUCTURE AND SCATTERING
Frank Alan Schmittroth (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-8063

Effective two-body potentials were studied for nuclei in the 2s-1d shell and the 1p shell via both structure and scattering calculations. The potential included a central Yukawa force with arbitrary exchange and a tensor force. Calculations were done by use of potential multipole expansions which allow the use of bound single-particle states. Effective potential strengths were obtained for nuclear structure by the application of a least squares criterion to effective two-body matrix elements. The prominent features of the potential obtained in this way were strong attractive even strenghts and weak repulsive odd strengths. These results were consistent between the two shells. The strength of the tensor force was not given consistently. Dissert. Abstr.

N70-19734# Addis Translations International, Woodside, Calif.
COLLECTIVE METHODS OF ACCELERATION
M. S. Rabinovich Berkeley, Calif. Calif. Univ. May 1969 54 p refs Transl. into ENGLISH from the Russian
(UCRL-Trans-1398; NP-17918) Avail: CFSTI

Basic physical problems involved in collective acceleration methods, electron rings, electron streams, plasma accelerators, magnetic-dissipation method of acceleration, the linear plasma betatron at the Technical Institute of the Academy of Sciences of the USSR, and the radiation method of acceleration are discussed. NSA

N70-19740# Atomic Weapons Research Establishment, Aldermaston (England).
NEUTRON SCATTERING BY U-235 AND Pu-239 FOR INCIDENT NEUTRONS OF 2, 3, AND 4 MeV
R. Batchelor and K. Wyld Aug. 1969 16 p refs
(AWRE-O-55/69) Avail: CFSTI

The secondary neutron spectra resulting from the fast neutron bombardment of U-235 and Pu-239 were measured as a function of angle for 2, 3, and 4 MeV incident energies, using a time-of-flight spectrometer. The spectra were analyzed on an absolute basis for the elastic scattered, inelastic scattered and fission components. The 2 MeV runs show slight evidence that the fission component is harder than anticipated. Author (NSA)

N70-19742# Atomic Energy Establishment, Winfrith (England).
WINTOF: A PROGRAM TO PRODUCE NEUTRON SPECTRA FROM ZEBRA TIME-OF-FLIGHT EXPERIMENTS
J. Marshall Jun. 1969 16 p refs
(AEEW-M-897) Avail: CFSTI

A computer program, written for the Winfrith KDF9 computer, which is used to calculate the neutron energy spectrum in the Zebra reactor from neutron time of flight measurements using the Zebra Linac is described. The data requirements for the program are specified and an illustration of the final spectrum is included. Author (NSA)

N70-19748# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
AUTOMATIZATION OF MEASUREMENTS OF REACTIVITY [AVTOMATIZATSIYA IZMERENII REAKTIVNOSTI]
A. A. Voronin and V. V. Ostapenko 1968 22 p refs In RUSSIAN
(IAE-1689) Avail: CFSTI

A general comparative evaluation was made of a method proposed for automatic reactivity measurements with regards to experimental feasibility, time, costs, and hazards involved. The method is based on the invariance theory and uses symbolic transfer functions and differential equations. Author (NSA)

N70-19749# Gosudarstvenni Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Fiziko-Energeticheskii Inst.
CALCULATION OF THE VARIATIONS OF REACTIVITY EFFECTS WITH THE AID OF THE PERTURBATION THEORY [VYCHISLENIE VARIATSII REAKTIVNOSTNYKH EFFEKTOV S POMOSHCH'YU TEORII VOZMUSHCHENII]
S. M. Zaritskii and I. D. Rakitin 1968 85 p refs In RUSSIAN
(FEI-136) Avail: CFSTI

Gas-kinetic, diffusion and finite-difference formulas and equations of perturbation theory are presented. The equations are intended for calculating the variations of different reactivity effects, such as Na and Doppler reactivity coefficients. Author (NSA)

N70-19757# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
A STUDY OF THE TRANSVERSAL OSCILLATIONS OF THE BEAM IN THE HARD-FOCUSING CHANNEL, USING A METHOD OF SWITCHING OFF THE LENSES [IZUCHENIE POPERCHNYKH KOLEBANII PUCHKA V ZHESTKOFOKUSIRUYUSHCHEM KANALE METODOM VYKLYUCHENIYA LINZ]
I. M. Kapchinskii, V. K. Plotnikov, and E. D. Derienko 1969 14 p refs In RUSSIAN
(IFVE-INZH-69-3) Avail: CFSTI

A method of studying the transversal oscillations of the particles in the strong-focusing channel is worked out. The method is based on sequence switch off of the lenses and it was used for finding and localization of the channel errors. Author (NSA)

N70-19769 Yale Univ., New Haven, Conn.
STUDY OF T=3/2 STATES IN N 13
Micheal Joseph Le Vine (Ph.D. Thesis) 1968 123 p

Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-8379

A study of T=3/2 states in N-13 was carried out by observing these states as resonances in the compound system C-12 +p. The lowest T=3/2 state was observed as a resonance in the proton elastic scattering at E sub p = 14.231 + or -.006 MeV. A search for additional T=3/2 states was carried out by measuring excitation functions for elastic scattering and for several proton-induced reactions over the energy range from 17.0 to 21.5 MeV; two anomalies were found whose widths and locations suggest that they might be T=3/2 states: at 17.80 and 18.459 MeV. In order to obtain the spins and parities of these states as well as to extract the elastic partial widths for the resonances a program of phase shift analysis was carried out. Eight resonances were analyzed including the three which are thought to correspond to T=3/2 states in N-13. The two narrow resonances at 17.80 and 18.459 MeV are identified as T=3/2 states on the basis of their widths and locations. Dissert. Abstr.

N70-19803# United Kingdom Atomic Energy Authority, Harwell (England).

YIELDS FROM THE THERMAL NEUTRON INDUCED FISSION OF PU 241

I. F. Croall and H. H. Willis Aug. 1969 4 p refs

(AERE-R-6154) Avail: CFSTI

The cumulative yields of 13 nuclides from the thermal neutron induced fission of Pu-241 were determined. The independent yield of Nb-96 was also measured. Other measurements of Pu-241 fission yields are tabulated for comparison. Author (NSA)

N70-19808 Washington Univ., St. Louis, Mo.

OPTICAL-MODEL PARAMETERS FOR ELASTICALLY SCATTERED 30- AND 35-MeV He-3 IONS

John William Luetzelschwab (Ph.D. Thesis) 1968 144 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-9003

Measured differential cross sections are reported for 30-MeV He-3 ions elastically scattered from Al-27, Co-59, Ni-60, Y-89, Zr-90, Cd-114, In-115, and Sn-116 for angles between 6 and 165 deg and for 35-Mev He-3 ions elastically scattered from Co-59, Ni-60, In-115, and Sn-116 for angles between 6 and 140 deg. The data are compared with predictions of the nuclear optical model and potential parameters that produce optimum fits with a least squares computer routine are reported. Good fits at back angles for Al-27, V-51, Co-59, and Ni-60 are obtained only with the inclusion of a spin-orbit interaction with a magnitude of between 2 and 5 MeV for most cases. The back-angle data for these nuclei also tend to suppress discrete ambiguities in the potential well depths. A continuous ambiguity between the radius and the diffuseness parameters is found to be related to a constancy of the root-mean-square radius. Effects of experimental uncertainties on the potential parameters are presented. Dissert. Abstr.

N70-19818# California Univ., Livermore. Lawrence Radiation Lab.

ABSOLUTE CONTAINMENT OF A KILOCURIE H 3 TARGET AT A LOW ENERGY RESEARCH ACCELERATOR

Raymond G. Aune Aug. 1969 11 p refs Presented at the Second Intern. Conf. on Accelerator Dosimetry and Exptn., Stanford, Calif.

(Contract W-7405-eng-48)

(UCRL-19304) Avail: CFSTI

The experiment called for a gaseous tritium target containing several hundred curies that could be bombarded by a deuteron beam from the 88-inch cyclotron without accelerator contamination or personnel exposure. The problems and hazards associated with the use of these H-3 targets were investigated. Particular emphasis is placed on the use of high-speed vacuum valves activated by explosive squibs that receive their signal from a mass spectrometer; also, absorption pumps were used in order to have a complete closed pumping system. In addition, the system can very simply be incorporated to handle the bombardment of any radioactive target. Author (NSA)

N70-19819 Rutgers Univ., New Brunswick, N.J.

ELASTIC AND INELASTIC SCATTERING OF COMPLEX PARTICLES FROM VIBRATIONAL NUCLEI

William Savin (Ph.D. Thesis) 1968 146 p

Avail: Univ. Microfilms : HC $7.00/Microfilm $3.00 Order No. 69-7580

Elastic and inelastic differential cross sections were measured for 16 MeV deuterons scattered from Sn-112, 116, 118, 120, 122, and 124, Cd-110, 112, 114, and 116, and Te-126, 128, and 130. Differential cross sections were also measured for 24 MeV elastically and inelastically scattered helium-three from Sn-112, 116, 122, and 124. The states investigated were the 0 (+) ground state and the strongly excited one phonon quadrupole and octupole states. Optical model calculations were made for the deuteron elastic scattering by allowing all real and imaginary parameters to vary simultaneously. Discrete ambiguities in these parameters are discussed in light of recent calculations. Good fits to the experimental data were obtained. The optical model fits to helium-three elastic scattering data were made allowing only the real and imaginary radius to vary and good fits were obtained. Dissert. Abstr.

N70-19822# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.

CALCULATED PARAMETERS OF THE SELF-FOCUSING LINAC MODEL [RASCHETNYE PARAMETRY MODELI LINEINOGO USKORITELYA S FOKUSIROVKOI USKORYAYUSHCHIM POLEM]

A. P. Mal'Tsev, V. B. Stepanov, and V. A. Teplyakov 1969 47 p refs In RUSSIAN

(IFVE-INZH-69-2) Avail: CFSTI

The parameters for the self focusing proton linac model are calculated. The full energy of the model is 4.2 MeV, the pulsed beam current is 100 ml. The accelerating system is based on the H cavity. The focusing is provided with double gap tubes with fingers. The calculation technique is described and a total list of the formulas is given. The results of the calculations are represented in the form of the tables and diagrams. The model's construction is briefly described. Author (NSA)

N70-19823# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.

ANGULAR T-NONINVARIANT CORRELATIONS IN NUCLEAR ELECTROMAGNETIC RADIATION [UGLOVYE T-NEINVARIANTNYE KORRELYATSII V ELEKTROMAGNITNOM IZLUCHENII YADER OBZOR]

P. A. Krupchitskii 1968 51 p refs In RUSSIAN

(ITEF-650) Avail: CFSTI

Different effects in the processes of the emission and absorption of photons by nuclei which appear by violation of time-invariance (T) of strong and electromagnetic interactions of hadrons are considered in this review. These effects are the following: angular correlations of two cascade photons in the polarized nuclei decay, angular correlations in the photon resonant scattering by polarized nuclei by means of the Moessbauer effect. Simple analytic expressions for the angular correlation coefficients in the case of electric and magnetic dipole and quadrupole nuclear transitions with arbitrary spin values are given. Effects of virtual photon exchange which lead to the appearance of angular T-noninvariant correlations even with the existence of time invariance of strong and electromagnetic interactions of hadrons are discussed. The experiments on this problem are given and discussed. Author (NSA)

N70-19828# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
THE OSCILLATOR FUNCTIONS AND THE NUCLEAR MATTER, PART 2
G. F. Filippov 1969 11 p refs In RUSSIAN
(ITF-69-31) Avail: AEC Depository Libraries

A number of questions, connected with the application of oscillator functions to the investigation of the nuclear matter is considered. Author

N70-19833# United Kingdom Atomic Energy Authority, Harwell (England).
A LEAD-SHIELDED CELL FOR THE ANALYSIS OF ALPHA, BETA, GAMMA ACTIVE MATERIALS
G. W. C. Milner, A. J. Wood, and A. J. Fudge Jul. 1969 22 p refs
(AERE-R-6115) Avail: CFSTI

A cell with 4 in. thick lead walls was built for analytical work in support of the reactor development programs. A feature of this cell is that it consists of two separate interconnected units. One unit is fixed and is available for nondestructive analysis, sample preparation, posting operations, and sample storage. The second unit contains an interchangeable fiberglass box for chemical work. Details are given of the construction of the cell and of the permanently installed equipment. Typical cell operations are described. Author (NSA)

N70-19837# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
TO THE QUESTION OF THE QUASISTOCHASTICAL INSTABILITY OF OSCILLATIONS OF PARTICLES IN RING-SHAPED ACCELERATORS AND ACCUMULATORS [K VOPROSY O KVAZI-STOKHASTICHESKOI NEUSTOICHIVOSTI KOLEBANII CHASTITS V KOL'TSEVYKH USKORITELYAKH I NAKOPITELYAKH]
P. R. Zenkevich 1969 15 p refs In RUSSIAN
(ITEF-667) Avail: CFSTI

In the process of the single resonance crossing, the amplitude of the particle oscillations may begin to increase stochastically due to the influence of the external noise factors. Such quasi-stochastical instability is investigated. Author (NSA)

N70-19849# Oak Ridge National Lab., Tenn. Neutron Physics Div.
OGRE CROSS SECTION PACKAGE FOR USING PHOTON INTERACTION DATA IN ENDF/B FORMAT
D. K. Trubey and J. R. Stockton 27 Oct. 1969 11 p ref
(Contract W-7405-eng-26)
(ORNL-TM-2757) Avail: CFSTI

A new version of the OGRE Monte Carlo computer code system for gamma-ray transport makes use of ENDF/B formatted photon interaction data. These data may be either BCD or binary and eliminates the use of the OGRE-format BCD and binary master tapes and the master tape handling program (MASTAP). Author (NSA)

N70-19876# Brookhaven National Lab., Upton, N.Y. Physics Dept.
RECENT RESULTS FROM PION PION YIELDS KAON ANTIKAON AND KAON ANTIKAON YIELDS KAON ANTIKAON INTERACTIONS
Kwan Wu Lai 26 Jun. 1969 13 p refs Presented at Conf. on the Pion Pion and Kaon Pion Interactions, Argonne, Ill., 16 May 1969 Submitted for publication Sponsored by AEC
(BNL-14090; CONF-690521-9) Avail: CFSTI

A brief review is given of some important features and new developments in the kaon plus kaon yields kaon plus antikaon and pion plus pion yields kaon plus antikaon interactions. The quantum numbers of the two interactions, means of obtaining G = plus one states, and virtual meson (K) exchange in a relation of S resonance production between negative pion and proton and antikaon plus nucleon interactions are considered. NSA

N70-19877# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
THE NONLINEAR CHIRAL U(3) TIMES U(3) DYNAMICS OF LOW-ENERGY BB AND PB INTERACTIONS
Y. M. Lomsadze, V. I. Sabo, Z. Z. Torich, and A. G. Spiegel 1969 16 p refs Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev
(ITF-69-45) Avail: CFSTI

On the basis of the broken nonlinear chiral U(3) × U(3) dynamics the physical consequences are calculated for PB and BB interactions at low energies (up to approximately 50 MeV in the L frame). The results obtained are in satisfactory agreement with experiment. Author (NSA)

N70-19878# Oak Ridge National Lab., Tenn. Neutron Physics Div.
NEUTRON PHYSICS DIVISION Annual Progress Report, Period Ending 31 May 1969
Sep. 1969 133 p refs
(Contract W-7405-eng-26)
(ORNL-4433) Avail: CFSTI

Reported studies include research and development work on liquid scintillation detectors for linear accelerators, shielding design calculations for space stations and missile silo covers, and various particle scattering and spectra analyses. Proton or neutron inelastic scattering calculations were performed for aluminum-27, iron-56, lithium-7, oxygen-16, uranium-238 and yttrium-89; deuteron reactions and neutron time-of-flight spectra were obtained for zinc isotopes and energy levels were calculated for some niobium isotopes. G.G.

N70-19880# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
UPPER BOUND FOR PARTIAL-WAVE SCATTERING AMPLITUDE
J. E. Kontrosh and Yu. M. Lomsadze 1969 12 p refs Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev
(ITF-69-40; CONF-690417-16) Avail: CFSTI

Four Phragmen–Lindelof theorems and the lemma on Herglotz functions are modified. With their help the boundedness of the partial-wave amplitude Fe(s) in the complex upper a halfplane is proved from the analyticity thereof in this halfplane only. In all the proofs one taken into account that the partial-wave amplitude Fe(s) for real s is a distribution rather than a usual function. Author (NSA)

N70-19881# Tufts Univ., Medford, Mass.
HIGH ENERGY PHYSICS Progress Report
Sep. 1969 22 p refs
(Contract AT(30-1)-1984)
(NYO-1984-13) Avail: CFSTI

Brief summaries of experimental work on high-energy interactions completed or in progress are given. Also proposed experiments are described. The equipment and technical progress are discussed. NSA

N70-19892# Washington Univ., Seattle. Dept. of Physics.
SUBSTATE POPULATIONS AND NUCLEAR POLARIZATION PRODUCED BY INELASTIC ALPHA PARTICLE SCATTERING ON C 12
T. D. Hayward and F. H. Schmidt [1969] 45 p refs Sponsored in part by AEC
(RLO-1388-100) Avail: CFSTI

The normalized alpha-gamma angular correlation in the reaction plane for excitation of the 4.44-MeV, 2+ state of C-12 was measured at 22.750 MeV. These data yield the relative populations of the three magnetic substates referred to the normal to the reaction plane. The inelastic scattering process can then be dissected into partial differential cross sections to the substates. The nuclear polarization exhibits an oscillatory character as a function of angle. Comparison of the results with diffraction-model calculations, and with distorted-wave Born-approximation calculations is poor. In principle, the experimental method, though difficult, could be applied to nuclei which are more accurately described by nuclear models than is C-12. Author (NSA)

N70-19893# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
TUNING OF THE INJECTION CHANNEL OF THE IFVE 70-GeV PROTON SYNCHROTRON [NALADKA KANALA VVODA PUCHKA PROTONNOGO SINKHROTRONA IFVE NA ENERGIYU 70 GeV]
D. A. Demikhovskii, K. P. Lomov, E. A. Myae, M. F. Obchinnikov, and E. F. Troyanov 1968 25 p refs In RUSSIAN
(IFVE-SKU-68-76) Avail: CFSTI

The results of the tuning of the 70 GeV proton synchrotron injection channel are reported. The characteristics of the magnetic optic elements and the beam observation system are given. The methods and the results of the channel tuning by means of the proton beam are discussed. Author (NSA)

N70-19894# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
QUASI-INDEPENDENT QUARK MODEL: ADDITIVITY AND FACTORIZABILITY HYPOTHESES
A. P. Kobushkin and V. P. Shelest 1969 15 p refs
(ITF-69-24) Avail: CFSTI

A dynamical approach to the problem of hadron scattering is proposed in the model of the quasi-independent quark. Toward this end the unitary structure of the effective scattering potential is studied. It is shown that in this model the factorizability hypothesis resolves itself into additivity of the quark amplitudes. Relations for the elastic hadron scattering at large angles are derived. They are in good agreement with experiment. Author (NSA)

N70-19945# Los Alamos Scientific Lab., N. Mex.
NUCLEAR INTEGRATION OF DYNAMIC NUCLEAR SYSTEMS EQUATIONS BY OPTIMUM INTEGRATING FACTORS
Philip A. Secker, Jr. (Ph.D. Thesis—Arizona Univ., Tucson) 22 Oct. 1969 92 p refs
(Contract W-7405-eng-36)
(LA-4252) Avail: CFSTI

A numerical method, called the method of optimum integrating factors, is developed from a special integral equation solution of coupled first order nonlinear ordinary differential equation. An integrating factor with a complex exponent is formulated and a series approximation to the variable of integration is accomplished by expansion of the integrand in the integral equation into a Taylor series. The method is applied to step, ramp, and sinusoidal variations in reactivity for prompt and delayed neutrons; the method is also applied to an oscillating feedback condition. The integral equation, which serves as a basis for the integrating factor formulation, is derived and the integral functions are evaluated. The expression for the relative truncation error is derived. A computer listing of the numerical integration subroutine is included. NSA

N70-19946# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
INVESTIGATIONS OF NONLINEAR SYNCHROTRON FLUCTUATIONS
A. N. Dovbnya, S. G. Kononenko, L. V. Reprintsev, and A. M. Shenderovich 1968 5 p refs In RUSSIAN
(FTI-AN-347) Avail: CFSTI

Theoretical and experimental studies were made of resonances of nonlinear synchrotron oscillations and radiation damping in large-amplitude synchrotron oscillations. Effects of external fields and parametric resonances on the nonlinear synchrotron oscillations were studied using a 70 MeV electron storage ring. The results showed that the theoretical and experimental data are in good agreement. NSA

N70-19949# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RESONANCE MECHANISM OF MUON CAPTURE BY COMPLEX NUCLEI
V. V. Balashov, R. A. Eramzhyan, N. M. Kabachnik, G. Ya. Korenman, and V. L. Korotkikh 1969 25 p refs Presented at the Third Intern. Conf. on High Energy Phys. and Nucl. Struct., New York, 8–13 Sep. 1969
(JINR-E4-4801; CONF-690914-2) Avail: CFSTI

The physics of muon capture, which is the asymmetry of the neutron angular distribution, the structure of the neutron energy spectra, and the mechanism of charged particle emission, is discussed within the resonance model. The idea of the resonance mechanism in muon capture gives a general basis for further investigation (in the energy range corresponding to a giant resonance) of the process accompanying muon capture. Author (NSA)

N70-19950# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ENERGY DEPENDENCE OF THE INTERACTION CROSS SECTIONS OF PI-MESONS WITH THE ATOMIC NUCLEI AT ENERGIES MORE THAN 50 MEV
V. S. Bareshenkov, K. K. Gudima, A. S. Il'inov, and V. D. Tonaev 1969 19 p refs In RUSSIAN
(JINR-P2-4520) Avail: AEC Depository Libraries

The curves of the energy dependence of the integrated cross sections for the interaction of pi-mesons with He, Be, C, Al, Ti, Fe, Cu, Gd, Pb, U are given. Author (NSA)

N70-19952# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
ATOM TRANSPORT DOWN THERMAL AND ELECTRIC GRADIENTS IN SOLIDS
R. V. Hesketh 1969 30 p refs
(RD/B/N-1468) Avail: CFSTI

The heat of transport of a diffusing species is, by definition, the flux of heat carried in an isothermal situation by a unit flux of that species; it is the quantity of heat associated with a defect in a matrix and is proportional to the heat content of the matrix. It is $-(2AkT + 4BgammaT2/3)$, where 3k is the lattice specific heat, gamma T is the electronic specific heat, and the constants A and B define the respective volumes from which phonons and electrons are scattered; each constant is a positive pure number, and represents the number of atomic sites of the matrix which lie within the scattering volume surrounding the lattice defect. The scattering process always leads to forces pushing atoms down the phonon or electron energy gradient. Author (NSA)

N70-19954# Washington Univ., Seattle. Dept. of Physics.
INELASTIC SCATTERING OF 42-MeV ALPHA PARTICLES BY Mg 25
J. S. Blair and I. M. Naqib [1969] 46 p refs Sponsored in part by AEC
(RLO-1388-101) Avail: CFSTI

Cross sections were measured for elastic and inelastic scattering of 42 MeV alpha particles by Mg-25. Six inelastic alpha groups were identified at the following measured -Q values: 1.59, 1.94, 2.55, 2.75 (doublet), 3.400 (doublet), and 4.05 MeV. The

cross sections are analyzed in terms of the distorted-wave Born-approximation version of the extended optical model and the smoothed Fraunhofer inelastic diffraction model. A general discussion is given of the transition strengths of odd mass nuclei within the context of the strong coupling rotational model or modifications thereof and application is made to the present results. The main conclusions are: Inelastic scattering within the ground state band supports the rotational model in its simplest form. Comparison of the elastic cross sections from Mg-24, Mg-25 and Mg-26 indicates the presence of a quadrupole contribution to the elastic cross section from Mg-25 consistent with the strong coupling prediction. The excitation corresponding to the known level at 4.057 MeV suggests that this level arises from coupling a gamma vibration to the ground state band. Author (NSA)

N70-19957# National Accelerator Lab., Batavia, Ill.
STUDY OF THE PION PION SYSTEM FROM THRESHOLD TO 1 GeV
Ernest Malamud and Peter Schlein (California Univ., Los Angeles) May 1969 42 p refs Presented at the Conf. on the Pion Pion and Kaon Pion Interactions, Argonne, Ill. Sponsored in part by AEC
(NAL-29; CONF-690521-8) Avail: CFSTI

A detailed angular correlation analysis was performed on a high statistics compilation of the reaction negative pion proton yields negative pion, positive pion, neutron. This analysis, using the peripheral one-pion exchange dominated events, provided measurements of the following: s-wave pion pion phase shifts from the kaon mass to 1 GeV, neutral rho parameters, and certain combinations of the helicity amplitudes. The problem of using negative pion proton yields negative pion, neutral pion, proton to measure delta sub s to the 2nd power is discussed. The phase shifts are compared with results from pole extrapolation and it is shown how the helicity amplitudes obtained can be used to make predictions for other reactions. Author (NSA)

N70-19959# Minnesota Univ., Minneapolis. Dept. of Physics.
AN ANALYSIS OF PROTON ELASTIC SCATTERING USING POTENTIALS DERIVED FROM NUCLEON DENSITY DISTRIBUTIONS AND TWO BODY POTENTIALS
G. W. Greenlees, W. Makofske, and G. J. Pyle [1969] 36 p refs Sponsored in part by AEC
(COO-1265-81) Avail: CFSTI

Proton elastic scattering data at 30.3 MeV are analyzed using the optical model recently developed by Greenlees, Pyle, and Tang. The present analysis differs from that given in the original paper in using a model-exact treatment of the spin orbit and isospin terms of the potential. The quality of the fits obtained is insensitive to the detailed manner in which the potential is constructed and, in particular, to the choice of nucleon – nucleon force parameters. These parameters are therefore taken from an analysis of low energy nucleon – nucleon scattering data thus enabling the present analysis to give nuclear neutron rms radii. The n-p rms radius difference is about zero for medium weight elements and 0.1 to 0.2 F for heavy elements. Evidence is presented supporting the conclusion that the volume integral and the rms radius of the real central potential are the well defined quantities which can be deduced from analyses of elastic proton scattering data. Author (NSA)

N70-19962# Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics.
OCTUPOLE AND QUADRUPOLE TRANSITION RATES IN F 19 FROM SCATTERING OF 15 MeV DEUTERONS
D. Dehnhard and Norton M. Hintz [1969] 29 p refs Sponsored in part by AEC
(COO-1265-82) Avail: CFSTI

Angular distributions of 15.0-MeV deuterons scattered by F-19 were measured between Theta sub LAB = 18 and 85°. Inelastic groups leaving F-19 in its five lowest lying excited states were observed using two position-sensitive detectors placed in the focal plane of a split-pole spectrometer. The elastic scattering cross section was analyzed using an optical model. B(E2) values for the transitions from the 5/2 + (0.197 MeV) and the 3/2 + (1.58 MeV) states to the g.s. were found to be 9 + or − 3 and 10 + or −3 W.U.(single particle units). They were calculated from the beta sub 2 deformation parameter extracted from a DWBA analysis using a complex form factor derived from the optical model analysis with a surface absorption term. These results are in good agreement with results obtained from inelastic proton scattering and from Coulomb excitation experiments. Author (NSA)

N70-19964# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
LAGRANGIAN FORMALISM FOR THE HALF-INTEGRAL SPIN FIELDS WITHOUT ADDITIONAL CONDITIONS
R. P. Zaikov 1969 17 p refs In RUSSIAN
(JINR-P2-4515) Avail: CFSTI

The Lagrangian formalism is considered both for finite component fields of half-integral spin without exclusion of the lowest spins and for infinite component fields (which are transformed on nonunitary representations of SL(2,C) group) with an arbitrary mass spectrum. It is shown that the free field Lagrangian can be constructed, from which follows positively definite energy. In the case of finite component fields the formalism is canonical. The interaction with an arbitrary tensor field is considered. Author (NSA)

N70-19967# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
HIGH-ENERGY PARTICLE PATHS IN PHOTOEMULSION AND FREON
V. S. Barashenkov and R. M. Rizvanova 1969 5 p ref In RUSSIAN
(JINR-P2-4521) Avail: CFSTI

The dependence of the particle paths in emulsion and freon on the interaction cross section of an incident particle with a free nucleon is presented. Author (NSA)

N70-20007 Princeton Univ., N.J.
A MODEL FOR PHOTONS AND GRAVITONS BASED ON BROKEN SYMMETRY
Hans C. Ohanian (Ph.D. Thesis) 1968 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-10516

A dynamical model is presented in which photons and gravitons are regarded as Goldstone bosons associated with a breakdown of Lorentz symmetry. Such a model of the photon has been constructed for a spinor and a scalar field. A detailed discussion is given of both the spinor and scalar cases. The electromagnetic interactions between charged fermions appear as a consequence of a fundamental current-current self-coupling. The Lorentz symmetry is broken by assigning a constant nonzero vacuum expectation value to the fermion current operator. Interactions between this nonzero vacuum current and the bare fermions are treated by a generalized Hartree-Fock procedure. The resulting quasi-particle solutions are identified with physical particles. Examination of the quasi-particle field operators and of the quasi-particle vacuum reveals that different values of the vacuum current lead to unitarily inequivalent representations of the operator algebra. Dissert. Abstr.

N70-20017# Brookhaven National Lab., Upton, N.Y.
EXPERIMENTAL STUDIES OF RESONANCE NEUTRON CAPTURE GAMMA RAYS
R. E. Chrien 5 Aug. 1969 50 p refs Presented at Intern. Symp. on Neutron-Capture Gamma-Ray Spectry., Studsvik, Sweden, 11-15 Aug. 1969 Sponsored by AEC
(BNL-13884; CONF-690802-2) Avail: CFSTI

The usefulness of gamma-ray spectroscopy of resonance neutron capture reactions in nuclear structure studies is examined from several points of view. Illustrations are given of the applications of resonance gamma-ray spectroscopy. Some of the interpretations of the available experimental data are discussed. NSA

N70-20022 Catholic Univ. of America, Washington, D.C.
MEASUREMENT AND ANALYSIS OF O 18(p, GAMMA) F 19
Kenneth Laverne Dunning (Ph.D. Thesis) 1968 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-8892

The yields from four resonances in the O-18(proton,gamma)F-19 reaction were determined with the proton beam from a Van de Graaff accelerator after it has passed through a magnetic analyzer and a two-meter electrostatic analyzer. The average beam energy was known to within a few parts in 10,000 and its energy spread was about .02% at half maximum. Fortran programs were developed for numerical analysis of the yields curves. The yield formula used is an integral over the single-level Breit-Wigner cross section, the beam energy distribution and an energy loss distribution given by the theory of P. W. Vavilov. The prediction of Vavilov's theory did not give good agreement with the experimental yields from Ta2O5 targets but modification of a parameter in the theory let to agreement. This parameter, the number of electrons per target molecule, was reduced. Dissert. Abstr.

N70-20025 Syracuse Univ., N.Y.
BROKEN SU(3) AND STRONG DECAYS
Pejavar Sridhar Rao (Ph.D. Thesis) 1968 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-8647

The model makes the following hypotheses: (1) The coupling constants and the dispersion relation subtraction constants are SU(3) - invariant. (2) The masses used in the evaluation of the matrix elements are the physical masses, and are not SU(3) - invariant. (3) Perturbation techniques. This amounts to saying that perturbation theory is good for checking percentage deviations, or alternatively, that it is a self-consistency check. On the basis of the third hypothesis, the decay matrix elements are identified with the amplitudes for a triangle graph, and are evaluated explicitly for the strong decays. The intermediate lines of the triangle graph are also assumed to belong to the same three multiplets. It follows than that there are four different modes for the decay, and calculations are carried out for each mode separately. Dissert. Abstr.

N70-20031*# Southern Methodist Univ., Dallas, Tex. Dept. of Physics.
PENETRATION AND INTERACTION OF PROTONS WITH MATTER. PART 1. THEORETICAL STUDIES USING MONTE CARLO TECHNIQUES Research Report, 1 Jun. 1964-31 Aug. 1968
Martin Leimdorfer and George W. Crawford, eds. Aug. 1968 72 p refs
(Grant NsG-708)
(NASA-CR-108228; RR-68-2) Avail: CFSTI CSCL 20H

The Monte Carlo transport program and its development are described. The type or types of incident nucleons, the energy, energy spectrum, and direction of the particle flux, and type of matter, its size and shape through which the nucleons travel can be selected. The concept of the linear stopping power is discussed, and equation is developed for the total average energy loss by ionization per unit path length per density of the stopping materials. The equation is used for part of the collision problems in developing the flexible transport codes. Specific applications are described for simulating transport of neutrons and protons with energies below 400 MeV, depth dose distribution produced by transport of 185 MeV protons through silicon, and lateral leakage of protons from silicon rods bombarded by monenergetic protons in the energy range of 50 to 187 MeV. N.E.N.

N70-20032# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
T-INVARIANCE CHECK IN 635-MeV ELASTIC PROTON-PROTON SCATTERING
R. Ya. Zulkarneev, V. S. Nadezhdin, and V. I. Satarov 1969 8 p refs
(JINR-E1-4850) Avail: CFSTI

Polarization-asymmetry equality following from interaction T-invariance was checked in pp-scattering at 635 MeV. No effects of T-invariance violation were found in the angle region of (34 to 117 deg) c.m.s., the experimental accuracy being 2 to 4%. The T-nonparity scattering amplitude was estimated. The value of sin lambda sub 2 = -0.11 + or - 0.10 was found for the noninvariance phase lambda sub 2. Author (NSA)

N70-20033# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
SOME CONSEQUENCES OF THE CHIRAL U(3) TIMES U(3) DYNAMICS FOR VECTOR AND AXIAL VECTOR RESONANCES
V. I. Sabo and Z. Z. Torich 1969 9 p refs In RUSSIAN Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev
(ITF-69-42) Avail: CFSTI

The vector and axial vector mesons are introduced into the chiral U(3) × U(3) dynamics in a guage invariant way. Decay widths of these mesons are calculated both without symmetry breaking and with symmetry breaking. Results are in satisfactory agreement with experiment. Author (NSA)

N70-20041# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
IS IT POSSIBLE TO DESCRIBE THE LOWER STATES OF EVEN NUCLEI JUST BY THE COLLECTIVE LEVELS OF FREEDOM? [VOZMOZHNO LI OPISANIE NIZHNIKH SOSTOYANIICHETNYKH VADER TOL'KO KOLLEKTIVNYMI STEPENYAMISVOPODY]
D. P. Grechukhin 1968 71 p refs In RUSSIAN
(IAE-1635) Avail: CFSTI

The ratio of the intensities of the M1 and E2 components of mixed (M1 + E2) transitions of even nuclei in the case of collective phenomenological models is practically independent of the concrete structure of the model, but is determined by how completely the collective (boson) variables are separated from the totality of the nucleonic coordinates. That is, the ratio of the intensities of the M1 and E2 components can serve as a criterion of the applicability of phenomenological description of the collective excitations of the nuclei, in which it is assumed that the state of a nucleus can be determined as the state of a Hamiltonian not containing any other degrees of freedom than the quadrupolar collective (boson). In accordance with that statement an analysis was made of practically all experimental data known on 1 January 1968 for mixtures of M1 and E2 components in transitions of even nuclei in the range 16 < or = A < or = 254. A table of data is presented. Author (NSA)

N70-20042# Stanford Research Inst., Menlo Park, Calif.
COLLISION SPECTROSCOPY OF 2(3)S EXCITATION IN He BY He(+) IMPACT
Dewitt Coffey, Jr., D. C. Lorents, and F. T. Smith 28 Jul. 1969 5 p refs Sponsored in part by AROD and by AEC
(SRIA-115-P-78-1) Avail: CFSTI

Differential cross sections for excitation of the 2(3)S state in He by He(+) were measured at center-of-mass energies from 300 eV down to 37.5 eV. The deflected current, the angle of scattering, and the energy loss of the scattered ions were measured. Results are presented in the form of a plot of the reduced cross section as a function of the reduced angle. Prominent features of the process are discussed briefly. NSA

N70-20043# Atomic Weapons Research Establishment, Aldermaston (England).
MEASUREMENT OF (N,2N) AND (N,3N) CROSS SECTIONS AT 14 MeV INCIDENT ENERGY
D. S. Mather and L. F. Pain Aug. 1969 27 p refs
(AWRE-O-47/69) Avail: CFSTI

A large liquid scintillation counter was used with a pulsed 14.1-MeV neutron source to measure (n,2n) and (n,3n) cross sections for H-3, He-3, Li-6, Li-7, B-10, B-11, Y, Cu, Pb, and U-238. The measurements are based on the fission cross section of U-238 using a new method of flux measurement and antineutrino for Cf-252 spontaneous fission for the detector efficiency calibration. Author (NSA)

N70-20044# Indiana Univ., Bloomington. Dept. of Physics.
DEPARTMENT OF PHYSICS Final Report, 1 Apr. 1964-31 Aug. 1969
Lawrence M. Langer Dec. 1969 13 p refs
(Contract Nonr-1705(02))
(AD-698178) Avail: CFSTI CSCL 20/8

The objectives of the contract were in the area of Nuclear Spectroscopy. The overall aim has been to obtain information which could extend a knowledge of nuclear structure by studying the properties of radiation emitted by radioactive isotopes. More specifically, the investigations have involved: The determination of decay modes and spin and parity assignments of nuclear levels; Precision studies of the detailed shapes of beta-spectra in allowed and forbidden transitions; and Beta-gamma angular correlation measurements. TAB

N70-20079 Stanford Univ., Calif.
THE ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON FROM SIDEWISE DISPERSION RELATIONS
Dennis Joseph Silverman (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8269

The electromagnetic form factors of the nucleon are studied by analytic continuation in the mass of one of the external nucleons of the electromagnetic vertex. The threshold contribution to the absorptive part dominates the dispersion relation is assumed and the multipoles for electropion production using the low energy theorem derived from PCAC and current algebra by Adler and Gilman are calculated. Threshold dominance in a sidewise dispersion relation was found to account for the anomalous magnetic moments of the electron and nucleon by Drell and Pagels. The assumption is tested by calculating the electron's form factor in order alpha. Whereas threshold dominance works very well for the electron's radius and anomalous magnetic moment, it gives poor results at large momentum transfers. The isovector magnetic moment and isovector radius of the nucleon's form factor is analyzed. From the qualitative result for the isovector radius, it is concluded that the nucleon's electromagnetic radius is larger than the pion's due to the large range of the nucleon's pion cloud. Dissert. Abstr.

N70-20081 Rutgers Univ., New Brunswick, N.J.
THE REORIENTATION EFFECT IN CADMIUM AND TIN ISOTOPES
Alan Marc Kleinfeld (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-7556

Coulomb excitation is used to determine the static quadrupole moment of the first 2(+) state and the reduced electric quadrupole transition probabilities from the ground to the first 2(+) state (B(E2,0(+) → 2(+)) of Cd-105, Cd-114, Sn-116, and Sn-124. The range of values of the quadrupole moment and B(E2,0(+) → 2(+) so determined are given. The Coulomb excitation interpretation of these experiments was examined by performing the measurement for three different projectiles and observing the mass dependence of the reorientation effect. It is concluded that Coulomb excitation is a reliable tool with which the static quadrupole moment can be determined. The results are compared to the predictions of existing nuclear models. In their present state the models are found to be lacking in consistency as regards the experimental evidence for these nuclei. Dissert. Abstr.

N70-20087# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INVESTIGATION OF THE NEGATIVE MASS EFFECT ON THE ADGEZATOR MODEL
P. I. Ryltsev, V. P. Sarantsev, and V. P. Fartushnyi 1969 26 p refs In RUSSIAN
(JINR-P9-4620) Avail: CFSTI

Instability of the negative mass type in dense electron beams in the adgezator model (adiabatic generator of charged toroids) has been investigated. The experimental results agree with recent theoretical predictions on the effect of screening on the oscillation increment in the perturbed beam. Author (NSA)

N70-20088# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi I Eksperimental'noi Fiziki.
CONDENSERS FOR BENDING BEAMS OF CHARGED PARTICLES [KONDENSATORY DLYA ZAVORACHIVANIYA PUCHKOV ZARYAZHENNYKH CHASTITS]
L. L. Gol'din and S. V. Skachkov 1969 16 p refs In RUSSIAN
(ITEF-651) Avail: CFSTI

To bend beams of charged particles it is highly desirable to use condensers with an electric field which is uniform after averaging along the trajectories of the particles. The field of such a condenser specially designed to be installed into vacuum chambers of ion-guides and accelerators has been experimentally studied. Condenser electrodes have been placed along the surface of a cylinder on oval cross-section and have been separated by a gap which seems to have a form of a broken line when viewed from above. It is shown that the averaged field is uniform with a precision of 4% at distances greater than the gap width from the electrodes. Author (NSA)

N70-20094# Rensselaer Polytechnic Inst., Troy, N.Y.
LINEAR ACCELERATOR PROJECT Progress Report, 1 Apr.-30 Jun. 1969
30 Jun. 1969 103 p refs
(Contract AT(30-3)-328)
(RPI-328-162) Avail: CFSTI

Progress is reported for 29 linear accelerator investigations on: (1) neutron cross sections, (2) fast reactor physics, (3) low energy neutron inelastic scattering, and (4) miscellaneous measurements. D.L.G.

N70-20100# Arkansas Univ., Fayetteville. Dept. of Chemistry.
A BIBLIOGRAPHY ON HEAVY ATOM KINETIC ISOTOPE EFFECT RESEARCH, JULY 1959-JUNE 1969
Arthur Fry, G. H. Bennett, C. R. Everly, W. Meek, M. Oka et al
1 Sep. 1969 32 p refs
(Contract AT(40-1)-3234)
(ORO-3234-12) Avail: CFSTI

Four hundred thirty-eight references are presented on non-hydrogen kinetic isotope effects, covering the literature from July 1959 through June 1969. Papers are classified by element in alphabetical order and cross references are included. Some general theory and review papers and some papers of related interest are also referenced. NSA

N70-20102# Sandia Corp., Albuquerque, N.Mex.
ELECTRONIC PROPERTIES OF RARE EARTH-HYDRIDES
R. C. Heckman Nov. 1969 35 p refs
(SC-RR-69-571) Avail: CFSTI

The literature on the electrical conductivity, Hall effect, magnetic, nuclear magnetic resonance, and positron annihilation properties, and on the electronic heat capacities of the rare earth

hydrides is reviewed. Discussion is focused on the implications of the results of electronic property measurements with regard to hydrogen to metal bonding and conduction band populations. It is concluded that hydrogen in these materials is largely protonic, the hydrogen electron being added to the material conduction band. At limiting compositions, such as CeH3.0, the conduction band is approximately filled. Author (NSA)

N70-20120 Washington Univ., Seattle.
THE ROLE OF THE ADJOINT IN NEUTRON FLUCTUATION ANALYSIS, WITH SPECIAL EMPHASIS ON THE DETECTOR EFFICIENCY
Myron Edward Congdon (Ph.D. Thesis) 1968 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-7039

The fundamental equations for fluctuations about the mean neutron density are studied for a reactor-detector system in which the detector is treated as an integral part of the system. The reactor-detector system is described, mathematically, as a general Markov process, and expressions for various descriptive parameters are derived in a consistent manner, within the context of the basic equations. The role of the general adjoint neutron density is discussed, with special emphasis on the mean and second-moment functions. A relationship between the second-moment equations similar to the relationship between first-moments is observed. A reduction of the second-moment equations is carried out, without approximation, using a variational principle. This consistent reduction allows a definition of the paramaters involved, especially a definition of the detector efficiency, through a comparison of this reduced form with the usual point-reactor equations. Dissert. Abstr.

N70-20123# European-American Nuclear Data Committee, Paris (France).
NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY Progress Report, 1 Jan.-31 Dec. 1968
Mar. 1969 255 p refs Partly in FRENCH
(EANDC(E)-115-U) Avail: AEC Depository Libraries

The nuclear Research in EURATOM is reported. Included are: (1) neutron cross sections for copper 63, 65, dysprosium, holmium 165, manganese 55, lutetium; (2) decay schemes for niobium 99, 100, 101, yttrium, zirconium 99, and 101; and (3) energy level schemes for gold 198, mercury 200, oxygen 16, and samarium 153. NSA

N70-20124# Washington Univ., Seattle. Nuclear Physics Lab.
NUCLEAR PHYSICS LABORATORY Annual Report
Jun. 1969 166 p refs
(Contract AT(45-1)-1388)
(RLO-1388-96) Avail: CFSTI

The research during this period is reported. Included are the following: (1) alpha reactions for different energies with copper; (2) deuteron reactions with germanium, lithium 7, molybdenum 92, and zirconium 90; (3) deuteron inelastic scattering for magnesium, and (4) alpha inelastic scattering for carbon 12, and gold 197. NSA

N70-20131 Cornell Univ., Ithaca, N.Y.
PHOTOPRODUCTION OF PHI MESONS FROM CARBON AT 1800 MeV
Paul Joseph Mostek (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-5770

The photoproduction of phi mesons from carbon was measured at a mean photon energy of 1800 MeV using a pair spectrometer to detect positive kaon negative kaon pairs in a mass region extending from 1006 MeV to 1042 MeV. The experimental mass resolution has a FWHM of about 4 MeV. Pulse heights produced in three liquid Cerenkov counters were recorded for each event and analyzed to reject pions, electrons and protons. Spark chambers were used for reconstruction of trajectories. Approximately 165 phi's were observed. Values obtained were consistent with a vector dominance prediction using neutral rho meson photoproduction data, SU sub 3 coupling constants and a quark model prediction for the rho-nucleon and phi-nucleon cross sections. Dissert. Abstr.

N70-20151# California Univ., Berkeley. Lawrence Radiation Lab.
THE ZERO-MASS-LIMIT APPROACH TO KINEMATICS AND VENEZIANO PARAMETERIZATIONS FOR PHOTON AMPLITUDES
Richard C. Brower 30 Jul. 1969 53 p refs
(Contract W-7405-eng-48)
(UCRL-19920; UC-34) Avail: CFSTI

The covariant photon amplitude is proved to be the smooth limit of the helicity amplitude for a massive vector boson. The kinematical consequences of this zero-mass limit and crossing are shown to include conservation of charge (for the equivalence principle in the case of the graviton), and the low energy theorems for photoproduction and Compton scattering. Consequently, the zero-mass limit is a practical alternative to the use of on-mass-shell gauge invariance. Moreover, the zero-mass limit provides a technique for the construction of Regge expansions and Veneziano parameterizations for photon amplitudes from the corresponding amplitudes for a massive vector boson. A model for the Pomeranchon which contributes to forward elastic Compton scattering and does not fall off at large q squared is proposed. Also a Veneziano parameterization of the amplitude for Compton scattering of off-mass-shell charged currents off pions is presented which satisfies the current algebra sum rule of Fubini, Dashen, and Gell-Mann. Author (NSA)

N70-20156 Alaska Univ., College.
EXCITATION FUNCTIONS FOR BALMER AND N2(+) FIRST NEGATIVE EMISSIONS PRODUCED IN COLLISIONS OF PROTONS WITH N2
John Sutherland Murray (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-8023

The emissions cross sections for, and polarization of, Balmer alpha and N2(+) first negative emissions, and the cross section for total charge exchange measured for proton-N2 collisions in a proton energy range of 1.5 KeV to 34 KeV. These emission cross sections are measured under conditions such that the population of the n =3 levels of hydrogen are in equilibrium. A knowledge of the relative populations of the n =3 degenerate states is, therefore, not needed. Consideration is also given to the cascade contribution in the Balmer alpha emissions. The Balmer alpha cross section reported here is larger than previously reported measurements and displays a definite structure. The N2(+) first negative (0,1) emission cross section and the total charge exchange cross section have the same shape and magnitude as those previously published. The measured polarization is less than one per cent for N2(+) first negative (0,1) emissions and at most 7 per cent for Balmer alpha emissions. Dissert. Abstr.

N70-20196 Iowa State Univ. of Science and Technology, Ames.
SOLUTION OF THE SPACE-TIME DEPENDENT NEUTRON KINETICS EQUATIONS FOR A REFLECTED SLAB REACTOR
James Hugh Mc Fadden (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-4258

A modal analysis technique is used to solve the space-time and space-frequency dependent neutron diffusion equations for a reflected slab reactor. A two-energy-group model is employed and delayed neutron effects are neglected in the solutions of the time dependent equations. The neutron flux is expanded in a series of known space functions multiplied by the corresponding time coefficients. The space functions are a form of the Green function modes and the Kantorovich variational method is used to determine the time coefficients. The frequency response of the reactor to a

localized driving function also is investigated. Solutions are obtained with four sets of trial functions, of which two sets include coupled modes, and are compared at various detector positions in the fuel and reflector regions. Guides are given for the selection of trial functions based on the locations in the reactor where the frequency response is to be determined. Dissert. Abstr.

N70-20207 Northwestern Univ., Evanston, Ill.
MOMENTUM TRANSFER DEPENDENCE OF THE GAMMA N N(*) VERTEX IN A DISPERSION THEORETICAL MODEL
Douglas Wallace Mc Kay (Ph.D. Thesis) 1968 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-6963

A new method is proposed to study the momentum-transfer dependence of the electropion production vertex on gamma, the square of the effective photon mass, which employs unsubtracted dispersion relations written in terms of the gamma-variable itself. A model is adapted in which only spinless pions, nucleons and photons are included. Emphasis is placed on complications of the gamma-plane singularity structure which result from the fact that the square of the final state pion - N mass is above threshold. Physical unitarity in the gamma-channel is extended to apply in unphysical regions and is approximated by the three intermediate states. Pole terms which play an important role in determining the gamma-plane singularity structure in the neighborhood of gamma = 0 are included in the crossed and subenergy channels. A version of the coupled channel N/D method is used to rewrite the dispersion relations as an equivelent set of partially decoupled, linear integral equations. A simple approximation to the inelastic form factor, based on the N/D method, is developed. Dissert. Abstr.

N70-20228 Washington Univ., St. Louis, Mo.
APPLICATION OF THE CORRELATED BASIS FUNCTION METHOD TO EXTENDED NUCLEAR SYSTEMS
Dennis Abraham Chakkalakal (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00
Order No. 69-8991

The correlated basis function method is applied to neutron matter and symmetrical nuclear matter. The ground state energy of each of these systems is calculated as a function of the particle density P. A modification of the Clark-Westhaus formalism for calculating the effects of some noncentral correlations is developed. Using this, preliminary estimates of the contribution to the energy per particle arising from the tensor force are obtained. Dissert. Abstr.

N70-20230# Texas A&M Univ., College Station. Cyclotron Inst.
RESEARCH AND OPERATION OF THE TEXAS A AND M VARIABLE ENERGY CYCLOTRON Progress Report, 1 Jun. 1968-1 Jun. 1969
1 Jun. 1969 100 p refs
(Contract AT(40-1)-3398)
(ORO-3398-15) Avail: CFSTI

Reported are deuteron irradiations and helium-3 reactions with calcium-40, strontium-88, and yttrium-89. Alpha reactions were observed on deuterium and thulium-169. Research and development activities for the cyclotron continued. G.G.

N70-20231 Yale Univ., New Haven, Conn.
THEORY OF THE ELECTROMAGNETIC PRODUCTION OF VECTOR MESONS
Robert Beck Clark (Ph.D. Thesis) 1968 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-8330

Problem of the electromagnetic production of vector mesons was studied. The general kinematical structure is discussed, and a set of invariant amplitudes is given. A technique was found for performing the complicated calculations which arise in diagrammatic models by computer. These techniques are then applied to two rather interesting problems. The contribution made by the exchange of a vector meson to the gamma + neutron yields rho meson(-) + proton differential cross section is calculated, and it is shown that information may be obtained from this process regarding the magnetic dipole and electric quadrupole moments of the rho meson. A model considering the contribution of the s-channel resonances to the gamma + proton yields rho meson(o) + proton differential cross section is studied, and promising results are obtained from a combination of the one pion exchange with form factor and the N(1680)5/2(-) resonance. Dissert. Abstr.

N70-20233# Kernforschungsanlage, Juelich (West Germany).
ALPHA-SPECTROMETRIC ISOTOPE ABUNDANCE ANALYSIS OF URANIUM USING SEMI-CONDUCTOR DETECTORS
W. Litzow and E. Merz 1969 27 p refs In GERMAN; ENGLISH summary Prepared for EURATOM
(Contract EURATOM-003-63-1 RGAD)
(THTR-90; EUR-4329d) Avail: CFSTI

Nuclear technology very often requires precise knowledge of the composition and enrichment of uranium isotopes, in particular the fissile isotopes U-235 and U-233. Because of its alpha-instability, spectrometry using semi-conductor detectors can be successfully used for quantitative determination. The accuracy of these abundance analyses depends mainly on the particle detection probability of the method, and also on adequate energy resolution because of the predominantly statistical sources of error. A particular advantage of this spectrometric method, and one which considerably simplifies evaluation is that the half-widths of the individual alpha-lines over the whole of the energy range from 4 to 5.5 MeV can be considered constant. To plot the alpha-spectra, a semi-conductor detector with a counting surface of 25 sq mm and an energy resolution of 17 keV half-width was employed. With the overall spectrometric device a maximum energy resolution of 19 keV was attained. The optimum conditions for the abundance analysis of the uranium stipulate an energy resolution of 25 keV and a particle detection probability of 0.5%. After measuring time of 72 h the enrichment factor of a U-235-enriched uranium mixture was ascertained to an accuracy of + or - 10%. Author

N70-20236# Atome Industriel, Orsay (France).
DESIGN AND TESTING OF MEASURING HEAD FOR X-RAY FLUORESCENCE ANALYSIS BY MEANS OF RADIOACTIVE SOURCES Final Report [ETUDE ET ESSAIS D'UNE TETE DE MESURE POUR L'ANALYSE PAR FLUORESCENCE X AU MOYEN DE SOURCES RADIOACTIVES]
C. Broquet and P. Merrer 1969 100 p refs In FRENCH; ENGLISH summary Prepared for EURATOM
(Contract EURATOM-111-67-4 IRAF)
(EUR-4399f) Avail: CFSTI

The aim of the present study was to design and construct a measuring head which in combination with a single-channel amplitude selector and a count scale could be employed as a portable appliance. As result of the study of the following solutions were decided on: the use of an Na I scintillating crystal and a photomultiplier for the detector, source mounted excentric to the sample-carrier window, selection of X-rays by a combination of balanced filters and a single-channel selector, preamplifier and VHT supply to be incorporated in the measuring head. Stability and sensitivity threshhold tests gave satisfactory results. The examples dealt with were the assay of Cu, Ca and Sn in an aqueous solution, of Fe and Ca in ores and of Zn in brass. The results obtained can, moreover, be improved by optimizing the characteristics of the head, the principal parameters of which are discussed. Author

N70-20238# California Inst. of Tech., Pasadena. Arthur A. Noyes Lab. of Chemical Physics.
REACTIVE COLLISIONS
Aron Kuppermann [1969] 30 p refs
(Contract AT(04-3)-767)
(CALT-767-P-4-47) Avail: CFSTI

The present state of a priori calculations of chemical reaction cross sections is reviewed, with emphasis on the hydrogen atom plus hydrogen molecule reaction. Some comparisons with experiments are included. Author (NSA)

N70-20239# Institute of Nuclear Research, Warsaw (Poland).
ANALYSIS OF DETECTION BY NEON HODOSCOPE
Jerzy Jatczak 1969 36 p refs
(INR-1064) Avail: CFSTI

The detection of EAS particles by an array of hodoscoped conversi detectors (neon flash tubes) is analyzed. The average number of conversi detectors hit by a single particle is found as a function of the angle the direction of the particle makes with the vertical. The probability of the particle causing detectors to flash is calculated as a function of that angle. The relation between the layer efficiency of the hodoscope and the zenith angle of the shower axis is derived. Author (NSA)

N70-20241# Oak Ridge National Lab., Tenn.
NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN INFINITE HOMOGENEOUS AIR
E. A. Straker and M. L. Gritzne Dec. 1969 433 p refs
(AD-697901; ORNL-4464) Avail: CFSTI CSCL 18/6

The detailed energy, angular, and spatial distribution of neutrons and their secondary gamma rays is given for nine source energy groups, a fission spectrum, and a typical thermonuclear spectrum. Results for ranges to 2000 meters for the eleven sources are supplemented with results to 5000 meters for a fission and 12.2- to 15-MeV source. In addition to the detailed description of the radiation field, the angular distributions of Henderson dose, Snyder-Neufeld dose, tissue kerma, mid-phantom dose, concrete kerma, air kerma, ionizing silicon kerma, and non-ionizing silicon kerma are given for neutrons, and the Henderson dose, concrete kerma, air kerma, and silicon kerma are given for secondary gamma rays. Some comparisons with air-over-ground results are made. Author (TAB)

N70-20266# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
POLARIZED PROTON TARGET AS THE NEUTRON POLARIZER
V. I. Luschikov, Yu. V. Taran, and F. L. Shapiro 1969 43 p refs In RUSSIAN
(JINR-P3-4409) Avail: CFSTI

Theoretical grounds for the method of neutron polarization by transmission through a polarized proton target are presented. In this way 65% polarization of neutrons in the resonance energy region (up to several tens of keV) was reached with the help of a target of lanthanum-magnesium nitrate (LMN) monocrystal reducing the intensity of the neutron beam by 5 times; the target area being 15 sq cm. The method is effective as well for the thermal and cold neutron polarization, giving a considerable gain in the aperture ratio as compared to the other known methods. Different cross sections which determine the effect of a neutron polarizer with the LMN crystal on 0.001-50 eV neutrons are presented. Author (NSA)

N70-20267 Yale Univ., New Haven, Conn.
NEW DATA AND IMPROVEMENTS IN NUCLEON-NUCLEON PHASE PARAMETER ANALYSIS
Robert Edward Seamon (Ph.D. Thesis) 1968 328 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 69-8431

Multiple energy phase-parameter fits to proton-proton and neutron-proton scattering data separately and combined have been obtained, and tests of long-range charge independence have been made. Causality requirements for the energy dependence of uncoupled and coupled phase parameters and the calculation of corrections needed to convert data obtained from proton-deuteron scattering to equivalent free neutron-proton measurements, taking into account S-wave final state inter-neutron detection are discussed and applied. The possible presence of unknown sources of error in the data has been looked into and some data definitely out of line with the general trends have been removed. Dissert. Abstr.

N70-20269 Cornell Univ., Ithaca, N.Y.
TWO PHOTON EXCHANGE IN ELECTRON PROTON SCATTERING
Gary Kalman Greenhut (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-5762

An investigation is made of the two photon exchange contribution to electron-proton scattering. The contribution to the differential scattering cross section is calculated using both the second Born approximation and the distorted wave approximation. Potentials representing the charge distribution and the magnetic moment distribution of the proton are used. Recoil proton polarization is calculated using the second Born approximation. A fit to the proton Compton scattering data up to 1100 MeV is made using an amplitude composed of the proton Born terms neutral pion and neutral eta meson exchange terms and Breit-Wigner resonance terms. The four nucleon resonances with masses less than 1700 MeV and elasticities into the pion-nucleon channel greater than 50% are used. The resulting amplitude is extended to the case of off mass shell photons and the resonance portion used to calculate the resonance contribution to electron-proton scattering. Dissert. Abstr.

N70-20271 Stanford Univ., Calif.
SPIN-ORBIT COUPLING IN METALS BY THE METHOD OF PSEUDOPOTENTIALS
Clinton Joseph Cooney (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-8168

A pseudopotential form of the Pauli equation, which contains spin-orbit coupling, was obtained to describe valence states of nearly free electrons in metals. This pseudopotential form was rewritten by use of properties of the Pauli eigenfunctions; the pseudopotential operator was separated into a one-component pseudopotential, similar to that previously derived for the nonrelativistic Schrodinger equation, and a pseudopotential spin-orbit operator. The spin-orbit contribution to the energy-band structure was determined. It was shown that spin-orbit coupling plays a large role in the band structure. On the other hand, it was shown that the spin-orbit pseudopotential plays a small role in the total energy of the system. Dissert. Abstr.

N70-20277*# Oak Ridge National Lab., Tenn.
TABULATED CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 62-MeV AND 29 MeV PROTONS ON Al 27
F. E. Bertrand and R. W. Peelle Nov. 1969 61 p refs
(NASA Order L-12186; Contract W-7405-eng-26)
(NASA-CR-108894; ORNL-4455) Avail: CFSTI CSCL 20H

Tabulated differential cross sections are presented for the production of proton, deuteron, triton, helium-3, and alpha particles from Al-27 bombarded by 62- and 29-MeV protons. At 62 MeV, continuum cross sections are listed at 18 angles from 12 deg through 160 deg, while at 29 MeV data are given at only three angles. The low-energy cut-offs on the spectra range from 3 to 6 MeV. Angular distributions are given for excitation by 62 MeV protons of states at 0, 2.2, 2.7, and 3.0 MeV in Al-27, and at 0, 1.06, 2.07, and 4.7 MeV in Al-26. Author

N70-20288 Stanford Univ., Calif.
APPLICATION OF CLUSTER EXPANSIONS TO THE DYNAMICS OF SPIN SYSTEMS
George Florent Reiter (Ph.D. Thesis) 1968 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8249

A systematic investigation of the dynamics of spin systems has been made using a cluster expansion of the non-equilibrium density matrix as the principal analytic tool. The methods employed are applicable to any system describable in terms of localized spins, but most of the specific results are confined to the Heisenberg model. By neglecting correlations between groups of two, three, etc., spins, a uniquely defined hierarchy of equations is obtained that described the dynamics in increasing detail. The first approximation in this scheme neglects all correlations between spins, and is usually called the random phase approximation, or RPA. For any Hamiltonian that does not contain single-ion anisotropy terms, the RPA is shown to be equivalent to the linear spin wave theory obtained from the Holstein-Primakoff transformations, in the sense that the equilibrium spin configurations and spin wave frequencies obtained from either method are identical at low temperatures. This equivalence is lost when single ion anisotropy terms are included, unless the anisotropy is small enough to be treated as a perturbation. A prescription for converting the anisotropy terms into boson equivalents is given that preserves the agreement between the two methods up to terms that are second order in the ratio of anisotropy energy to exchange plus Zeeman energy. The prescription differs from that given previously in the literature.
Dissert. Abstr.

N70-20289# Joint Inst. for Nuclear Research, Dubna (USSR).
RADIATION ESCAPE BEYOND THE SHIELDING OF THE JINR SYNCHROCYCLOTRON
V. E. Aleinikov, L. P. Kimel, M. M. Komochkov, and V. P. Sidorin 1969 8 p refs In RUSSIAN
(JINR-P16-4727) Avail: CFSTI

Using a proportional BF3-counter with the polyethylene moderator, the measurements of the neutron fluxes of different energy groups, escaping the shielding of the 680 MeV synchrocyclotron, were performed. The total yield of neutrons beyond the accelerator shielding is determined.
Author (NSA)

N70-20290# Joint Inst. for Nuclear Research, Dubna (USSR).
COHERENT ENERGY LOSSES OF A RELATIVISTIC BUNCH IN LINEAR ACCELERATING SYSTEMS
A. B. Kuznetsov and S. B. Rubin 1969 11 p refs In RUSSIAN
(JINR-P9-4728) Avail: CFSTI

The effect of the coherent radiation on the acceleration process of highly-charged bunches is considered. The dependence of the energy losses of a relativistic charge, passing various periodic structures, on the energy of this charge is analyzed.
Author (NSA)

N70-20291# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
IONIZATION OF ATOMIC BEAMS IN THE PENNING DISCHARGE WITH A HOT CATHODE
Yu. A. Plis and L. M. Soroko 1969 21 p refs In RUSSIAN Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 1-7 Sep. 1969
(JINR-P9-4653; CONF-690803-32) Avail: CFSTI

The characteristics of the Penning discharge with a hot cathode were investigated in the high-vacuum regime and in conditions of the atomic beam ionization. The parameters of the apparatus are the atomic beam ionization. The parameters of the apparatus are given which were used for measurements of: geometrical dimensions, magnetic field strength, anode voltage, discharge current, gas pressure in the discharge region, and value of the output ion current. Constitution of the beam from the discharge passing along the magnetic field was investigated; the electron and ion components are separated. The efficiency of atomic beam ionization in the discharge is estimated.
Author (NSA)

N70-20297# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
CONSISTENT APPROACH TO EXCHANGE CURRENTS AND THE NUCLEAR MANY BODY PROBLEM
P. Stichel and E. Werner (Inst. Fuer Theoretische Phys. der Tech. Univ). Aug. 1969 50 p refs
(DESY-69/28) Avail: CFSTI

A consistent treatment of two-particle exchange currents in nuclei in the framework of the one-boson-exchange-model for the nucleon-nucleon interaction is given. The general formalism for the evaluation of matrix elements of two-body currents in many-nucleon systems is outlined. Possible applications to the two-nucleon system are briefly discussed.
Author (NSA)

N70-20298# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
INCOHERENT PRODUCTION OF RHO(O)-MESONS FROM NUCLEI AND VECTOR DOMINANCE
G. von Bochmann and B. Margolis Aug. 1969 8 p refs
(DESY-69/30) Avail: CFSTI

Incoherent photoproduction of rho(o) mesons on the nucleus is calculated assuming vector dominance. The results are sensitive to the rho nucleon total cross section which is found to be decreasing with energy. One finds a relatively weak dependence on energy of the incoherent effective number.
Author (NSA)

N70-20307# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
INVESTIGATION OF (GAMMA, p) REACTIONS IN Li7 USING A BEAM OF QUASI-MONOCHROMATIC AND POLARIZED PHOTONS [ISSLEDOVANIE (GAMMA, p) REAKTSII NA LI 7 S POMOSHCH'YU PUCHKA KVAZIMONOKHROMATICHESKIKH I POLYARIZOVANNYKH FOTONOV]
Yu. P. Antufev, Yu. V. Zhebrovskii, L. Ya. Kolesnikov, V. S. Kuz'menko, I. I. Moroshnichenko et al 1968 10 p refs In RUSSIAN; ENGLISH summary
(NP-18038) Avail: CFSTI

The (gamma proton) reaction in Li-7 was investigated in a beam of coherent, linearly polarized bremsstrahlung obtained by slowing down electrons on a diamond single crystal. The measured sensitivity of the (gamma, proton) reaction in Li-7 to photon polarization agrees qualitatively with that for processes of the photoproduction of ions on free nucleons. The results show that proton yield in the photodisintegration of nuclei for energies and angles corresponding to the kinematics of the photoproduction of pion-mesons on free nucleons is basically caused by a meson mechanism of photon interaction.
Author (NSA)

N70-20309# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PHOTOPRODUCTION OF LEPTON PAIRS ON ELECTRONS
D. Yu. Bardin, J. Boehm, V. B. Semikoz, D. Fakirov, and N. M. Shumeiko 1969 12 p refs In RUSSIAN
(JINR-P2-4644) Avail: CFSTI

The cross sections for the processes gamma e yields e(+)1(-) were calculated without taking into account the exchange diagrams.
Author (NSA)

N70-20314# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SECOND ORDER INFINITE COMPONENT WAVE EQUATION
M. Huszar and Ya. Smorodinskii 1969 11 p refs
(JINR-E2-4716) Avail: CFSTI

As a straightforward generalization of the Majorana equation an infinite-component second-order wave equation is investigated with the aid of the noninvariance group U(3,1). The mass spectrum obtained is degenerate in the sense that equation describes several particles with integer spin belonging to the same mass value. Relation to the three-dimensional oscillator is briefly discussed.
Author (NSA)

N70-20316 Yale Univ., New Haven, Conn.
SPIN WAVES IN K2 Ir-Cl 6
Fred Martin Reames (Ph.D. Thesis) 1968 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-8414

The techniques of far infrared spectroscopy have been used to examine the elementary excitations of the antiferromagnetic ground state of K2IrCl6. Two excitations have been observed directly, the antiferromagnetic resonance at 9.5/cm and a two-magnon absorption at 13.5 /cm. The energy of a second resonance at 2.0/cm has been inferred from the effects of a magnetic field on the 9.5/cm resonance. A theoretical analysis, using spin wave theory and magnetic space group theory, has been performed for the antiferromagnetic type 3A ordering of K2IrCl6. It is found, however, that a physical mechanism for the two-magnon absorption does not exist unless the symmetries of type 3A ordering are reduced. A chemical lattice distortion superimposed on the magnetic space group symmetries is found to be the means by which this reduction occurs in K2IrCl6; the introduction of this distortion allows a comparison of the spin wave theory and the experimental observations. Discrepancies between the results of this comparison and results in the literature are interpreted by means of the chemical lattice distortion. Dissert. Abstr.

N70-20317# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TRIPLET REPRESENTATIONS OF D-FUNCTIONS
1969 6 p refs In RUSSIAN
(JINR-P2-4684) Avail: CFSTI

Triplet representations of D-functions are obtained which are a part of the expression for a statistical weight of the many-particle state. Author (NSA)

N70-20318 Lehigh Univ., Bethlehem, Pa.
PHONON LIFETIME EFFECTS IN THE THERMAL CONDUCTIVITY OF A DIELECTRIC CRYSTAL
Frederick William Ostermayer, Jr. (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-7354

An equation for the thermal conductivity of an anharmonic dielectric crystal was derived by Green's function techniques from the correlation function formula for thermal conductivity. The crystal is assumed to be perfect and terms above third order in the Taylor series expansion of the crystal potential energy are neglected. The correlation function formula applied to a dielectric crystal requires that the time integral of the phonon number-number correlation function be calculated. This was done starting from the Dyson equation for the one-phonon imaginary time Green function with a particular approximation for the self-energy. The approximation, which was derived by the functional derivative method corresponds to interactions in which a phonon splits into two, or two phonons combine to form one. Dissert. Abstr.

N70-20319# Institute of Nuclear Physics, Krakow (Poland).
TRANSISTORIZED MODULAR SYSTEM FOR SLOW NEUTRON SPECTROMETRY
Tadeusz Zaleski, Wiktor Olejarczyk, and Janusz Sokolowski Feb. 1969 9 p refs In POLISH
(INP-676) Avail: CFSTI

A transistorized modular system using boron trifluoride proportional detectors for slow neutron spectrometry developed in the Neutron Laboratory at the Institute of Nuclear Physics, Krakow, is described. Several systems of this type are operating with the pulsed reactor at the Joint Institute of Nuclear Research in Dubna (SU) and at the Brosi Kidric Institute of Nuclear Research (Yugoslavia). Construction details and technical data of individual modules are given. Author (NSA)

N70-20323# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ACCOUNT OF POSSIBLE EXPERIMENTAL RESTRICTIONS BY CALCULATING RADIATIVE CORRECTIONS TO PION ELECTRON SCATTERING
D. Yu. Bardin, V. B.Semikoz, and N. M. Shumeiko 1969 9 p refs In RUSSIAN
(JINR-P4-4532) Avail: CFSTI

The radiative corrections to pion electron-scattering were calculated for the experiment in which finite particle energies and the angle of emission of recoil meson are measured. The conditions are pointed out under which the obtained results are valid for the case when the angle of emission of recoil electron is measured in addition and the momentum complanarity is checked. Author (NSA)

N70-20324# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW MEASUREMENTS OF THE ANGULAR DEPENDENCE OF THE DEPOLARIZATION PARAMETER IN 635-MeV pp SCATTERING
R. Ya. Zulkarneev, V. S.Nadezhdin, and V. I. Satarov 1969 19 p refs In RUSSIAN
(JINR-P1-4536) Avail: CFSTI

The results of new measurements of the D sub pp parameter at 635 + or - 9 MeV are described. For the scattering angles of 12, 15, 18, 21, 27, 32, 41, 49 and 55 deg (lab. syst.) the values of D sub pp(theta) are found to be equal 1.14 + or - 0.24; 0.940 + or - 0.079; 0.890 + or - 0.078; 0.872 + or - 0.030; 0.913 + or - 0.050; 0.708 + or - 0.080; 0.697 + or - 0.040; 0.707 + or - 0.070; 0.480 + or - 0.090, respectively. The results are discussed from the point of view of the M(12) and SU(12)^{e} sub L symmetries. Author (NSA)

N70-20325# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOPRODUCTION OF CHARGED PION PAIRS ON PROTONS
H. Alvensleben, U. Becker, William K. Bertram, M. Chen, K. J. Cohen et al Sep. 1969 12 p refs Prepared jointly with MIT
(DESY-69/132) Avail: CFSTI

A high statistics (100,000 events) measurement of photoproduction of charged pion pairs on protons is reported. First, the measured cross sections are presented in a three-dimensional data matrix where all the dynamical features are explicitly shown. Second, fitting the data in the energy region 2.6 to 6.8 GeV with various assumptions of rho mesons production indicates that the photoproduction of rho mesons decreases with increasing energy similar to pion-nucleon scattering. Author (NSA)

N70-20327 Carnegie-Mellon Univ., Pittsburgh, Pa.
SELECTIVE AXIAL DETECTION ELECTRON DIFFRACTION SYSTEM
Helen Janet Nee (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-3944

A technique is described in which an electric field deflects diffracted electrons onto a detector. The technique permits electron diffraction patterns to be interpreted electrically and, consequently, almost instantaneously. When applied to reflection electron diffraction of electrons from thin films, it should be useful in following crystallographic changes which take place during growth and during the stabilizing processes that occur after deposition. Ordinarily, the diffracted electrons proceed along the elements of a right circular cone, the axis of which is the extension of the incident beam. An electrode, placed on this axis, and having cylindrical symmetry, therefore, acts alike on all electron trajectories in a specific cone. All the electrons in one cone can then be deflected by the electrode back to a point on the axis where a detector has been positioned. An analysis of this technique, assuming a spherical

electrode, shows the interesting result that the determination of crystal structure does not depend on a knowledge of the wave length of the incident radiation. Dissert. Abstr.

N70-20328# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
NEUTRON-DIFFRACTION INVESTIGATION OF HEMATITE IN MAGNETIC FIELD TO 120 kOe ON PULSED FAST REACTOR
P. S. Antsupov, R. A. Voskanyan, R.Z.Levitin, S.Nizel, V. V. Nitts et al 1969 22 p refs In RUSSIAN
(JINR-P14-4548) Avail: CFSTI

The technique of investigation of monocrystal magnetic structure in a strong pulsed magnetic field by neutron diffraction using the time-of-flight method is described. The effect of the field (to 120 kOe), which is parallel to the second-order axis, on the magnetic structure of the weak ferromagnetic, hematite below the Morin point is investigated. Anomalous increase of the neutron scattering on the plane (111) in the 48 kOe field was observed. The direction of the magnetic moments deflection from C3 axis is determined as well as the sign of the constant of the anisotropy term. The experiments were performed on the pulsed fast reactor. Author (NSA)

N70-20330 Syracuse Univ., N.Y.
PROPERTIES OF THE K*(1420) MESON
Barton Goz (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-8627

An exposure of K meson(-) proton interactions at 4.6 and 5.0 Bev/c beam momentum obtained at the Brookhaven National Laboratory 80 in hydrogen bubble chamber was studied. This analysis yielded a clear K*(1420) signal in several final states. A measurement of the K*(1420) spin-parity is obtained by comparing the observed production and decay angular distributions with those predicted by a model of (1420) production via one particle exchange with omega dominance. The comparison indicates that J(P) = 2(+) is strongly favored over 1- and 3-. In addition the data allows for the determination of several (1420) branching ratios. These measurements together with other known 2(+) meson branching ratios are compared with the predictions of unbroken SU(3). The theory is found to be consistent with presently available data. Dissert. Abstr.

N70-20331# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SCATTERING OF PARTICLES WITH NON-ORTHOGONAL INTERNAL STATES
V. L. Lyuboshits 1969 18 p refs In RUSSIAN
(JINR-P2-4631) Avail: CFSTI

The elastic scattering of two particles the internal states of which are superpositions of the alpha/A > +beta/B and gamma/A > +delta/B > type, is considered. It is shown that the differential and total cross sections depend on the degree of the superposition nonorthogonality. In this case the identical superpositions of one and the same states are scattered as identical particles. The collisions of nonstationary superpositions of particles with different masses are analyzed. The dependence of the elastic and total cross section on the proper time of flight of two packets is investigated. Author (NSA)

N70-20332# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
RESONANCE PRODUCTION IN 4-PRONG PI PLUS P-INTERACTIONS AT 2.34 GeV/C
N. Angelov, I. M. Gramenitskii, and Kh. Kanazirski 1969 26 p refs In RUSSIAN
(JINR-P1-4611) Avail: CFSTI

A method for determination of the resonance parameters in 4- and 5-body reactions is described. The cross sections for the single production of N*(1238), rho, omega resonances as well as the values of channels for the joint production of N*rho, omega, and eta resonances at 2.34 GeV/c are presented. The data on cross sections in the region of primary pion(+)-meson momenta of 1-8 GeV/c are compared. Author (NSA)

N70-20334# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
ELECTROPRODUCTION OF N* (1236) IN THE RESONANCE REGION, PART 2
Fritz Gutbrod Sep. 1969 30 p refs In GERMAN
(DESY-69/33) Avail: CFSTI

Ladder diagrams containing nucleon exchange for pi N-scattering and for pion electroproduction in the N*(1236) channel were calculated in the resonance region. Using the technique of Pade approximants, scattering and electroproduction amplitudes are constructed from the perturbation series, which converge well with increasing order of the Pade approximants. Two different cut-off procedures for the exchanged nucleon are investigated, as well as inelastic corrections in the direct channel, and the cut-off parameters are adjusted to give the correct scattering phase shift at the resonance position. With the N*-Bethe-Salpeter wave function determined by the nucleon exchange potential and its cut-off parameters, photo- and electroexcitation amplitudes of the resonance are calculated, assuming single nucleon and pion exchange gamma NN*-transition potentials. The dependence of the normalization of the photoproduction amplitudes on the cut-off parameters in the transition potential is only weak, and the momentum transfer dependence of the multipoles is almost independent of the details of the transition potential. Author (NSA)

N70-20343 North Carolina State Univ., Raleigh.
AN INVESTIGATION OF SOME SECOND ORDER ELECTROMAGNETIC NUCLEAR DECAY PROCESSES
Edward Joseph Seykora (Ph.D. Thesis) 1968 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-7667

Some second-order nuclear decay processes were studied using two NaI detectors to investigate the gamma-ray spectra which were in coincidence with the K x-rays following the decay of Hg-203 and Cs-137. Such gamma-ray spectra represent a composite distribution from both internal Compton scattering and two-quantum decay. The resultant gamma-ray spectra were found to be in good agreement with the semiclassical distributions predicted for internal Compton scattering. Dissert. Abstr.

N70-20353# California Univ., Berkeley. Lawrence Radiation Lab.
SEARCH FOR AN ELECTRON MASS SHIFT IN Cs 133 IN AN INTENSE ELECTROMAGNETIC FIELD
Richard J. Mowat 15 Aug. 1969 90 p refs
(Contract W-7405-eng-48)
(UCRL-19245) Avail: CFSTI

The possibility that the mass of a bound electron changes when placed in an intense electromagnetic field was investigated both theoretically and experimentally. The atomic-beam magnetic-resonance technique was used to examine hyperfine-structure shifts Cs-133 that occur when the atom is subjected to an intense, nonresonant magnetic field perpendicular to the static C field. A 2921-MHz TM sub 010 cavity was situated between Ramsey separated oscillatory loops which induced the transitions of interest. Shifts were observed for six DeltaF = + or - 1, Deltam sub F = + or - 1 transitions at field-independent points. No evidence was found for an electron mass shift. Excellent agreement was found between all observed shifts and those expected from a multilevel Bloch-Siegert effect. Theoretical reasons, based upon perturbation theory, are given for the nonoccurrence of the mass-shift effect in the ground state hyperfine-structure of a hydrogen-like system. Author (NSA)

N70-20355# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
VELOCITY OF SIGNAL PROPAGATION AND SPACE-TIME METRIC IN NONLINEAR ELECTRODYNAMIC
Dao Vong Duc and Nguyen Van Hieu 1969 21 p refs In RUSSIAN
(JINR-P2-4605) Avail: CFSTI

It is shown that in the nonlinear electrodynamics the propagation velocity of a perturbation which does not depend essentially on the time variable, and which can be considered as a signal, depends in the external field on the density of the field. It is also shown that this velocity can exceed that of the light in vacuum. Consequently, in the external field the ordering (in time) of the emission and the absorption of the signal can depend on the reference system of the conventional formulas of Lorentz transformations. A possibility of overcoming the difficulty by the introduction of a time depending space-time metric or by the introduction of a new selection principle that would enable one to exclude non-linear Lagrangians admitting superlight signals is discussed. Author (NSA)

N70-20356# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
DISCONTINUOUS PHASE OSCILLATIONS IN PARTICLE ACCELERATORS [DISKONTINUIERLICHE PHASENSCHWIGUNGEN IN TEILCHENBESCHLEUNIGEN]
G. Bathow and E. Freytag Aug. 1969 30 p refs In GERMAN
(DESY-69/29) Avail: CFSTI

Phase oscillations in particle accelerators are comprehensively treated for the case of discontinuous acceleration. A phase oscillation parameter Z is introduced into the difference equation for the phase and energy deviations. This quantity Z covers the influence of the characteristic accelerator parameters on the phase motion; it also describes the phase amplitude damping. The results given show that, for accelerators having a constant Z of the order 1, resonances will occur which critically influence the phase stability. Analytic approximations are given for a qualitative survey of the numerical results. Author (NSA)

N70-20360# Joint Inst. for Generalized Research, Dubna (USSR). Lab. of High Energy.
EXTRACTION OF THE ELECTRON FROM ADGEZATOR
K. A. Reshetnikova and V. P. Sarantsev 1969 16 p refs In RUSSIAN
(JINR-P9-4678) Avail: CFSTI

To extract the electron ring (containing ions) from the adgezator it is suggested to use additional coils, which are powered at a specified time. This moment is chosen at the increasing field in the main coils. Owing to the induction field, a part of the magnetic barrier is eliminated and the distribution of the magnetic field, necessary for the ring extraction, is created by the end of the process. Gradients of the magnetic field necessary for ion holding are maintained due to the additional coils. Author (NSA)

N70-20371# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
THE SYSTEM OF CONNECTION OF THE SCINTILLATION HODOSCOPE IN LINE WITH THE COMPUTER MINSK-22 [SISTEMA SVYAZI STSINTILLYATSIONNOGO GODOSKOPA V LINIYU S EVM MINSK-22]
A. E. Belotsvetov, L. V. Belyaevskii, A. A. Derevshchikov, V. D. Zhichenkov, Yu. A. Matulenko et al 1968 16 p refs In RUSSIAN
(IFVE-SEF/SVM-68-78) Avail: CFSTI

The system connecting the scintillation hodoscope in-line with the computer Minsk-22 is described. The results of of the operation of this system in the 70 GeV proton beam are reported. Author (NSA)

N70-20374# Indiana Univ., Bloomington.
THE INDIANA UNIVERSITY SPARK CHAMBER GROUP Technical Report, 1 Dec. 1968-30 Nov. 1969
[1969] 16 p refs
(Contract AT(11-1)-2009)
(COO-2009-4) Avail: CFSTI

A review of experiments planned and in progress by the spark chamber group on pion + proton and proton + proton interactions during this period is reported. A list of articles published during this period is also included. NSA

N70-20379# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
ELECTROMAGNETIC INTERACTIONS
E. Lohrmann Jul. 1969 101 p refs Presented at the Intern. Conf. on Elementary Particles, Lund, 1969
(DESY-69/21; CONF-690608-9) Avail: CFSTI

A review of electromagnetic interactions covering the status of quantum electrodynamics and electron-muon universality, photoproduction, and elastic and inelastic electron-nucleon scattering is presented. NSA

N70-20380# Paris Univ., Orsay (France). Faculte des Sciences.
LEVEL SCHEMES OF SOME ODD-Z NUCLEI DECAYING BY ALPHA EMISSION [ETUDE DES SCHEMAS DE NIVEAUX DE QUELQUES NOYAUX DE TRANSITION DE Z IMPAIR, ALIMENTES PAR EMISSION ALPHA]
Chin-Fan Leang (Ph.D. Thesis) 1969 95 p refs In FRENCH
(NP-17967) Avail: AEC Depository Libraries

The level scheme of the elements Fr-219, Fr-220, Fr-221, At-217, Bi-213, and Ac-227, formed by the alpha emission of Ac-223, Ac-224, Ac-225, Fr-221, At-217, and Pa-231, was studied with different measurement methods. These elements are located, for the most part, in the region between spherical nuclei and greatly deformed nuclei. The theoretical models which describe these two categories are inexact for the nuclei of Fr and At. The construction of level schemes for these elements, therefore, is based only on experimental results. The studies began with alpha magnetic spectography. Because of rapid methods of preparation of sources, the alpha magnetic spectra of the short-lived isotopes Fr-221 and Ac-223 were obtained for the first time. The placement of gamma transitions was determined by the method of alpha-gamma bidimensional coincidences. NSA

N70-20381# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ANGULAR DISTRIBUTION IN THE REACTION PION( ) + p YIELDS e(+) + e(-) + n
Yu. S. Surovtsev and F. G. Tkebuchava 1969 6 p refs In RUSSIAN
(JINR-P2-4524) Avail: CFSTI

The angular distribution in the reaction pion(-)p yields e(+) e(-) n is considered on the basis of the previously performed general analysis of the matrix element structure of the process pion N yields N gamma (virtual). Author (NSA)

N70-20383# Istituto Nazionale di Fisica Nucleare, Pisa (Italy). Inst. di Fisica.
PROCEEDINGS OF HIGH ENERGY PHYSICS MEETING, PISA, ITALY, 9-11 OCTOBER 1967
A. Scribano 1967 384 p refs In ENGLISH and FRENCH
(CONF-671079) Avail: CFSTI

Seventeen papers are presented on experimental and theoretical topics in high-energy physics. NSA

N70-20385# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
MEASUREMENTS OF THE LONGITUDINAL AND LATERAL DEVELOPMENT OF ELECTROMAGNETIC CASCADES IN LEAD, COPPER, AND ALUMINUM AT 6 GeV
G. Bathow, E. Freyteg, K. Tesch, R. Kajikawa (Nagoya Univ.), and M. Koebberling (Hamburg Univ.) Oct. 1969 18 p refs
(DESY-69/39) Avail: CFSTI

Electromagnetic cascades in lead and copper, initiated by 6-GeV electrons, have been calculated by the Monte Carlo method. These calculations are used for shielding design or design of quantameters and shower counters. Only the calculations of the longitudinal development of the cascade have been checked by an experiment performed at DESY. Concerning the lateral distribution, only measurements up to 1 GeV have been done. They seem to indicate a slower radial decrease than given by the calculations. Present measurements are intended to be a more stringent check of the 6-GeV Monte-Carlo calculations, especially regarding the radial distribution. By means of radiophotoluminescence-glasses, the energy deposition in lead, copper and aluminum was measured. To avoid errors, the dimensions of the dosimeters used should be small to permit the measurement of the steep gradient of the energy deposition near the shower axis. Author (NSA)

N70-20391# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

PERIPHERAL MODEL PREDICTIONS FOR PION (0) AND ETA MESON (0) PHOTOPRODUCTION

A. Dar, T. L. Watts (MIT), and V. F. Weisskopf (MIT) Aug. 1969 11 p refs

(DESY-69/31) Avail: CFSTI

Cross sections for photoproduction of pion (0) and eta meson (0) from nucleons with unpolarized and polarized photon beams were calculated using a new peripheral model for high-energy exchange reactions. The predictions are in good agreement with available data from CEA, DESY and SLAC on photoproduction from protons. Predictions for pion (0) photoproduction from neutrons are also presented. Author (NSA)

N70-20393# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

FORMULATION OF THE RHO-BOOTSTRAP WITH EXACT UNITARITY

G. N. Chermalykh 1969 12 p refs Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev

(ITF-69-47; CONF-690417-18) Avail: CFSTI

Using the fact that dispersion relation for the real part of the partial-wave amplitude is a singular integral equation relative to the inelasticity coefficient, and solving this equation with subsequent accounting of the crossing symmetry and conserving only P-waves in the crossed channels, the linear integral equation is formulated as the rho-bootstrap equation with exact unitarity in all the three channels. Author (NSA)

N70-20396 Lehigh Univ., Bethlehem, Pa.

CONTRIBUTION TO THE THEORY OF SCATTERING CRYSTAL LATTICES

Timothy Ling-Sung Nee (Ph.D. Thesis) 1968 117 p

Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7353

The anharmonic effects of the coherent scattering of slow neutrons by a single crystal have been studied at length for large energy and momentum transfers. The result of these studies shows that when anharmonic forces are present the delta-function peaks in the inelastic spectrum as predicted by the harmonic approximation are broadened into finite peaks with a relative shift in their mean positions. For small momentum and energy transfers, a singularity exists in the coefficients of the terms in the expansion which renders such an expansion inapplicable. A Green's function approach is developed in which the scattering function is expressed in term of certain one-phonon Green functions. It is shown by a study of the hierarchy of Green functions that such singularities are attributed to integrals of the energy denominators associated with certain two-phnon Green functions. A kinetic equation is derived for these two-phonon Green functions in the lowest order of the phonon-phonon coupling constant. Dissert. Abstr.

N70-20399# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).

[REACTOR CHEMISTRY, RADIONUCLIDES, NUCLEAR PROCESSES APPLIED TO SOLIDS, AND TRACE ELEMENTS, ISOTOPE EFFECTS, DATING] Annual Research Report, 1968

Oct. 1969 24 p

(HMI-B-84) Avail: CFSTI

Research progress is reported in the following areas: reactor chemistry, radionuclides; nuclear processes applied to solids; and trace elements, isotope effects, dating. NSA

N70-20400# Oak Ridge National Lab., Tenn.

SURVEY OF METHODS OF ACCELERATING HEAVY IONS

Robert S. Livingston Oct. 1969 45 p refs Presented at the Intern. Cyclotron Conf., Oxford, England

(Contract W-7405-eng-26)

(ORNL-TM-2686; CONF-690921-1) Avail: CFSTI

The many and varied methods for accelerating heavy ions to energies useful for nuclear physics and nuclear chemistry are reviewed. The traditional methods using cyclotrons and linear accelerators are being upgraded in a variety of ways. Schemes incorporating new accelerator physics, the collective effects systems, and charge changing systems are under development and may emerge soon as important new methods. Superconducting linacs are rapidly coming into their own and may be serious contenders as heavy ion accelerators in the near future. Author (NSA)

N70-20407# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi I Eksperimentalnoi Fiziki.

DEVIATIONS FROM THE STATISTICAL DESCRIPTION OF THE DISTRIBUTIONS OF THE SPACING BETWEEN THE NEUTRON LEVELS OF INTERMEDIATE AND HEAVY NUCLEI [OTKLONENIYA OT STATISTICHESKOGO OPISANIYA RASPREDELENII RASSTOYANII MEZHDU NEITRONNYMI UROVNYAMI SREDNIKH I TYAZHELYKH YADER]

S. I. Sukhoruchkin 1969 19 p refs In RUSSIAN

(ITEF-654) Avail: CFSTI

Analysis of the correlation properties of neutron levels of a broad scope of nuclei is described. The method of comparison of the deviations from the statistical distributions in low-lying and high excited nuclear states was applied to the energy intervals of several keV order of magnitude. Systematic correlations with the same parameters were found in both group of states, which indicates that the conditions of the statistical model at excitation energies close to the neutron binding energy are fulfilled incompletely. The model is discussed in which these correlations lead to the structure of several eV orders of magnitude. This structure is observable in neutron level spacing distributions of heavy N-even target nuclei. Author (NSA)

N70-20408# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.

FAST IONIZING FISSION CHAMBER [BYSTRAYA IONIZATSIONNAYA KAMERA DELENIYA]

Y. N. Kononov, A. A. Metlev, E. D. Poletaev, and Yu. S. Prokopets 1968 11 p refs In RUSSIAN

(FEI-143) Avail: CFSTI

A fast pulse fission chamber has been designed which permits registering with high eff fission fragments in the presence of a large background of alpha particles. Increased speed of action of the chamber was achieved as a result of direct use of current pulses forming in the chamber during the registration of charged particles and subsequent amplification of their discrimination by means of pulsed broad-band current devices. The chamber, containing 75 mg of Pu-239 (1.7 × 10 to the 8th power alpha-particles/second) has an efficiency of about 75%. The low intensity of the pulse front permits using the detector in experiments with nanosecond resolution. Author (NSA)

N70-20412*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

INTERACTION DIPOLE BETWEEN RARE-GAS ATOMS

W. Byers Brown and D. M. Whisnant 27 Aug. 1969 95 p refs

(Grant NGL-50-002-001)

(NASA-CR-108930; WIS-TCI-355) Avail: CFSTI CSCL 20H

A new formula is derived for the coefficient D sub 7 of the leading term R to the minus 7th power for the electric dipole moment of two atoms in S-states at a large distance R apart. An approximation is proposed which leads to a simple formula for D sub 7 involving mainly accessible atomic properties; the approximation is checked for scaled hydrogen atoms and is accurate to about one per cent. Rough values of D sub 7 are calculated for the rare-gas diatoms which indicate that the dispersion dipoles are of the opposite sign from the overlap dipoles calculated by Matcha and Nesbet, and can be of the same order of magnitude. A simple perturbation approach to the overlap dipole is proposed. Author

N70-20420# California Univ., La Jolla. Chemistry Dept.

PHOTOFRAGMENT SPECTROSCOPY OF DISSOCIATIVE EXCITED STATES

Kent R. Wilson 1 Dec. 1969 46 p refs Presented at the Symp. on Excited State Conf. on Chem. and Spectry., Anaheim, Calif. 7 Oct. 1969 Submitted for publication

(Contracts N00014-67-A-0109-0013; DA-31-124-ARO-D-257)

(AD-698158) Avail: CFSTI CSCL 7/4

A new form of molecular spectroscopy was developed to study dissociative excited electronic states. A molecular beam is crossed by pulses of polarized light and the distribution of recoiling photodissociation fragments is measured by a mass-spectrometer as a function of energy of the photons, mass of the fragments, translational energy of the fragments, and angle of fragment recoil with respect to the polarization direction. In experiments with a variety of molecular transitions it is shown that such information as the transition moment direction, the upper state symmetry, the identification of the fragments and their internal states, the bond strengths and the molecular dynamics of dissociation may be deduced from this multi-dimensional distribution. Author (TAB)

N70-20422*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

THE EXCHANGE FUNCTION W FOR H2 AND H2(+)

Philip R. Certaijn and Joseph O. Hirschfelder 12 Aug. 1969 34 p refs

(Grant NGL-50-002-001)

(NASA-CR-108929; WIS-TCI-351) Avail: CFSTI CSCL 20H

In the new partitioning perturbation formalism for electron exchange problems, the exchange function W plays an important role. For H2 and H2(+) the W is determined variationally in terms of a 14 term Slater orbital basis set. Tables are given for expressing W at 14 values of the internuclear separation ranging from R = 1a(0) to 20a(0). Author

N70-20423*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

DISSOCIATION ENERGY AND LONG-RANGE POTENTIAL OF DIATOMIC MOLECULES FROM VIBRATIONAL SPACINGS OF HIGHER LEVELS

Robert J. Le Roy and Richard B. Bernstein 13 Nov. 1969 45 p refs

(Grants NGL-50-002-001; NSF GP-7409)

(NASA-CR-108943; WIS-TCI-362) Avail: CFSTI CSCL 20H

An expression is derived which relates the distribution of vibrational levels near the dissociation limit D of a given diatomic species to the nature of the long range interatomic potential in the region where the latter may be approximated by D - C sub n/R(n). Fitting experimental energies directly to this relationship yields values of D, n, and C(n). This procedure requires a knowledge of the relative energies and relative vibrational numbering for at least four rotationless levels lying near the dissociation limit; however, it requires no information on the rotational constants, or on the number and energies of the deeply bound levels. D can be evaluated with a much smaller uncertainty than heretofore obtainable from Birge-Sponer extrapolations. The formula predicts the energies of all vibrational levels lying above the highest one measured, with uncertainties no larger than that of the binding energy of the highest level. The validity of the method is tested with model potentials and its usefulness is demonstrated. Author

N70-20431# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

ANALYSIS OF THE PION(+) p YIELDS N° RHO MESON(0) AND PION(+) p YIELDS N° OMEGA MESON (0) REACTIONS AT THE PION (+)- MESON MOMENTUM OF 2.3 GeV/c

N. Angelov, I. M. Gramenitskii, Kh. Kanazirski et al 1969 27 p refs In RUSSIAN

(JINR-P1-4657) Avail: CFSTI

The slope parameters and the behavior of the differential cross section d rho d+prime in the pion(+) p yields N° rho(0) and pion(+) p yields N° omega (0) reactions are discussed. The angular distributions of pion°, rho(0) and omega(0) resonance production and decay as well as the angular correlations between the resonances are considered with the help of the common spin density matrix. Author (NSA)

N70-20460# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ELECTROPRODUCTION OF N°(1236) IN A LADDER APPROXIMATION MODEL

Fritz Gutbrod Jul. 1969 50 p refs

(DESY-69/22) Avail: CFSTI

Electroproduction of N°(1236)is described by a model, in which the left hand cut of the pion production multipoles is approximated by the sum of ladder diagrams containing nucleon and pion exchange with cut-offs. The cut-off parameters have been fixed by use of scattering and photoproduction data. Taking the cut-offs independent of the virtual photon four momentum, predictions for the two transverse multipoles and for the scalar multipole are given. Special emphasis is laid on a discussion of the resonance shape for different momentum transfer. Author (NSA)

N70-20462# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INVESTIGATION OF THE FIRST BARYON RESONANCE BY THE METHOD OF ANALYTIC CONTINUATION INTO UNPHYSICAL REGION OF THE PION NUCLEON SCATTERING PARTIAL AMPLITUDE

B. L. Markovski and I. P. Nedyalkov 1969 15 p refs In RUSSIAN

(JINR-P2-4535) Avail: CFSTI

The method of analytic continuation of the partial amplitude on the unphysical sheet, proposed some time ago is applied to the investigation of the resonances which appear in the pN system at J = I = 3/2. Some information about the existence of the resonances with masses 1612 and 1688 MeV in addition to Delta 33 is obtained. Author (NSA)

N70-20463# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

ISOTOPIC AMPLITUDES AND PHASE-SHIFTS IN THE PROCESSES WITH THE PRODUCTION OF A FEW PARTICLES BELONGING TO ONE ISOTOPIC MULTIPLET

O. V. Dumbrais 1969 7 p refs In RUSSIAN

(JINR-P2-4621) Avail: CFSTI

It is pointed out that in the reactions (decays) with the production of a few particles belonging to one isotopic multiplet

there exists additional expressions for isotopic amplitudes and phase shifts by means of cross sections (probabilities). Some examples are presented. Author (NSA)

N70-20471 Indiana Univ., Bloomington.
A STUDY OF FINAL STATES WITH A KAON ANTIKAON PAIR PRODUCED BY 6.0 BeV/c NEGATIVE PI-MESONS IN HYDROGEN
Kenneth Anthony Potocki (Ph.D. Thesis) 1968 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-7113

The data collection and systematic reduction to produce the kaon antikaon sample are described. Event selection criteria are established to separate the various reactions. The total strange-particle cross section is estimated to be 2.95 + or - 0.30 mb. This indicates that reactions involving strange particles account for about 10% of the total pion(2) proton cross section at this energy. By comparison, this relative abundance of strange particles is found to be increasing with energy. Reaction cross sections are presented and found to be decreasing for three-body final states, cresting for four-body final states, and rising for five-body final states. The most prominently produced resonance in these data is K*(890), appearing in almost all the final states in which it could be formed. Dissert. Abstr.

N70-20499 National Lending Library for Science and Technology, Boston Spa (England).
THE SPINNER AND SOME OF ITS APPLICATIONS
A. Spadaveccnia et al 8 Aug. 1969 11 p refs Transl. into ENGLISH from from Helv. Phys. Acta (Basel), v. 40, no. 8, 1967 p 1063-1079
(NLL-AERE-1117-(9091.900F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

A new kind of detector for rare nuclear processes, called the spinner, is described. The principle is to produce negative pressures in a liquid by centrifugal forces. The metastable state can be destroyed as in the normal bubble chamber by energy deposition by particles. The spinner has so far proven useful for the determination of spontaneous fission rates and for the detection of very low neutron fluxes. Author

N70-20548# International Research and Technology Corp., Washington, D.C.
ON THE PRODUCTION AND SEPARATION OF INDUSTRIALLY USEFUL ISOTOPES IN SPACE
Theodore B. Taylor *In* NASA. Marshall Space Flight Center Space Progress, and Manufacturing 5 Feb. 1970 p 499-509
Avail: CFSTI

Preliminary work on a concept of an orbital facility for production and separation of industrially useful isotopes will be discussed. The production facility consists of a large solar powered electrical generator and a high current charged particle accelerator that produces isotopes by bombardment of a suitable target. Several possible methods for chemical or physical separation of the produced isotopes in space will be discussed. Emphasis will be placed on the production of plutonium or uranium-233 for use in terrestrial power reactors. Possible advantages of an orbital facility over a terrestrial one will be discussed. Author

N70-20549# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
STUDIES IN THE DECAY OF 29-min 81 SR
R. Broda, A. Z. Hrynkiewicz, J. Styczen, M. Szawlowski, Z. Szeglowski et al 1969 16 p refs
(JINR-E6-4658) Avail: CFSTI

The gamma rays accompanying the decay of Sr-81 were studied with Ge(Li) spectrometer in single and coincidence configurations. About seventy transitions were identified with the decay of 29-min Sr-81 and their energies and relative intensities were determined. On the basis of the observed coincidences the decay scheme of Sr-81 is proposed. Excited states were placed in Rb-81 at: 153.4, 188.3, 206.4, 301.2, 443.5, 574.6, 812.0, 820.0, 851.0, 865.5, 909.3, 1129, 1343.5, 1382, 1511, 1553 keV. The levels fed by positron decay were experimentally determined. Author (NSA)

N70-20551# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Physics.
CONFIRMATION OF THE EXISTENCE OF LONG-LIVED SPONTANEOUSLY FISSIONING NATURAL EMITTER
G. N. Flerov, N. K. Skobelev, G. M. Ter-Akopyan, V. G. Subbotin, B. A. Gvozdev et al 1969 12 p refs In RUSSIAN
(JINR-D6-4554) Avail: CFSTI

Using large proportional counters, the spontaneous fission in samples of lead glasses and natural minerals (galenas) was observed. For two samples of glass the measured spontaneous fission half-life referred to lead was found. The effect observed cannot be explained by spontaneous fission of the uranium impurity or by induced fission of lead and thorium. Analogous results were obtained also for two samples of galena. The experimental data presented prove the hypothesis of the existence of long-lived spontaneously fissioning nuclei. Author

N70-20553# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
STABILIZING EFFECTS OF SHELLS IN POSITIONS OF EXCITED LEVELS OF NUCLEI AND PARAMETERS OF THE STRUCTURE OF THE NEUTRON FORCE FUNCTION [STABILIZIRUYUSHCHIE EFFEKTY OBOLOCHEF V POLOZHENIYAKH VOZBUZHDENNYKH VROVNEI YADER I PARAMETRY STRUKTURY NEITRONNOI SILOVOI FUNKTSII]
S. I. Sukhoruchkin 1969 30 p In RUSSIAN; ENGLISH summary
(ITEF-655) Avail: CFSTI

Analysis of the experimental data on the excited-level positions of a broad range of nuclei confirms the stabilizing effect (found earlier) with the range of several tens of keV. The pairing effect in the single-particle level positions has a range about 1 MeV. Groupings in the values of the neutron separation energies and the neutron level positions of light nuclei can be expressed by the superposition of these two intervals. To obtain reliable values of strength functions when averaging the neutron widths of individual resonances it is necessary to fulfill the condition that the averaging interval exceed the characteristic energy period (30 keV). Author (NSA)

N70-20555# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.
PHYSICAL BASES OF ACTIVATION ANALYSIS OF CHARGED PARTICLES [FIZICHESKIE OSNOVY AKTIVATSIONNOGO ANALIZA NA ZARYAZHENNYKH CHASTITSAKH]
N. N. Krasnov 1968 17 p refs In RUSSIAN
(FEI-128) Avail: CFSTI

The principal correlations necessary for the practical uses of activation analysis by charged particles are considered. The correlations permit determination of elements by both absolute and relative methods. The formulas obtained are based on the use of the concept of isotope yield and an approximate expression for the path-energy ratio. Author (NSA)

N70-20560# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INVESTIGATION OF EIKONAL APPROXIMATION IN QUANTUM FIELD THEORY BY FUNCTIONAL INTEGRATION METHOD

B. M. Barbashov, S. P. Kuleshov, V. A. Matveev, and A. N. Sissakian 1969 23 p refs
(JINR-E2-4692) Avail: CFSTI

The efficacy of the functional integration method in quantum field theory for the study of the validity of the eikonal representation in the relativistic region and the structure of the effective quasipotential of two spinless particles at high energies is demonstrated. A closed relativistically invariant and cross symmetrical analytic expression for the scattering amplitude of two spinless nucleons in a model is obtained. Author (NSA)

N70-20561# Columbia Univ., New York.
S-MATRIX PHENOMENOLOGY OF PION PION SCATTERING
E. P. Tryon May 1969 23 p refs Presented at the Conf. on the Pion Pion and Kaon Minus Pion Interactions, Argonne, Ill.
(Contract AT(30-1)-1932)
(NYO-1932(2)-149; CONF-690521-7) Avail: CFSTI

The phenomenological approach to analyticity, unitarity, and crossing symmetry of the S matrix is described. It is shown how these properties of the S matrix can be used to determine the pion pion phase shifts up to energies approaching a GeV in terms of resonance masses and widths and the S wave scattering lengths a sub I and I = 0,2. The relevant equations are set up, and the method for solving them is outlined. Also the numberical values of a sub I and the phase shifts implied by them are discussed. NSA

N70-20601# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
PREPARATION OF A HIGH ENERGY GAMMA SOURCE BY ELECTRODEPOSITION OF TH 228 FROM FUSED SALTS
Robert C. Propst, Robert F. Overman, Thomas S. Mc Millan, and Earl J. Edeburn, Jr. Jun. 1969 38 p refs
(Contract AT(07-2)-1)
(DP-1166) Avail: CFSTI

A remote operation procedure is described for the preparation of sources containing several curies of Th-228 for photoneutron counting. The neutrons from (alpha,n) reactions in the source are reduced by electrodepositing the Th-228 from a molten cesium chloride-lanthanum chloride mixture into a liquid bismuth cathode. Sources prepared by this method have less than 6% of the neutron background of Th(NO3)4 sources. The deposition efficiency for the process is 60 to 75%. Author (NSA)

N70-20608*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
HARTREE-FOCK CALCULATIONS FOR THE GROUND AND FIRST EXCITED STATES OF H2
Joseph D. Bowman, Jr. Arnold C. Wahl, and Joseph O. Hirschfelder 15 Dec. 1969 32 p refs
(Grants NGL-50-002-001; NSF GP-12832)
(NASA-CR-108924; WIS-TCI-373) Avail: CFSTI CSCL 20H

The Hartree-Fock theory is reviewed and the procedures used to predict the behavior of singlet and triplet states when the nuclei are infinitely separated, are described. The results are presented, and the molecular orbitals and correlation energies obtained from the calculations are discussed. Author

N70-20610# Oak Ridge National Lab., Tenn.
THE 14 N(N, X GAMMA) REACTION FOR 8.5 < OR = EN < OR 11 MeV
J. K. Dickens and F. C. Perey 26 Nov. 1969 110 p refs Submitted for publication
(AD-698207; ORNL-TM-2778) Avail: CFSTI CSCL 20/8

Differential cross sections are given for the production of discrete-energy gamma rays by neutron interaction with nitrogen for E sub n between 8.5 and 11 MeV. Author (TAB)

N70-20611# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
SPLITTING EFFECT OF ELECTRON CYCLOTRON HARMONIC WAVES INTO DOUBLE MODES DUE TO TRANSVERSE TEMPERATURE
J. Olivain, F. Perceval, and M. Perulli 1969 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug.-6 Sep. 1969
(CEA-CONF-1395; CONF-690803-27) Avail: CFSTI

Frequency and wave number spectrum measurements were performed to analyze cyclotron harmonic waves in electron beams. In the case of two counterstreaming electron beams, these spectra exhibit a double peak structure which supports the theoretical prediction of cyclotron harmonic mode splitting due to the transverse temperature. Author (NSA)

N70-20616# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
VECTOR DOMINANCE AND FORWARD PHOTOPRODUCTION OF CHARGED PIONS
A. Dar Oct. 1969 14 p refs
(DESY-69/40) Avail: CFSTI

The validity of vector meson dominance (VMD) relations between photon initiated reactions and vector-meson initiated reactions is investigated within the framework of realistic models for high energy exchange reactions. The models suggest that the VMD relations should be valid at high enough energy, in the helicity frame. In particular the narrow forward structure that has been found in photon initiated reactions should be found also in the analogous hadron reactions, at high enough energy. Author (NSA)

N70-20619*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONTE CARLO CALCULATIONS OF A HEMISPHERICAL DUCT NEUTRON STREAMING EXPERIMENT
Lester Clemons, Jr., Gilbert N. Wrights, and Donald F. Shook Washington Mar. 1970 14 p refs
(NASA-TM-X-1971; E-4926) Avail: CFSTI CSCL 20H

Two hemispherical-shell-duct neutron-streaming experiments were set up in a water tank. Each duct consisted of the air space between two concentric plexiglas hemispheres of different radii surrounded by water. The ducts were 12.2 and 7.0 cm wide with duct centerline radii of 35.0 and 45.1 cm, respectively. PuBe neutron sources were located in each duct. A 5.10- by 4.65-cm-diameter NE-213 scintillator was used to measure the neutron fluxes at the duct mouth for the ducts empty and flooded with water. Monte Carlo calculations of the fluxes were compared with measurements. Agreement was good for the ducts empty and fair for the ducts flooded. Author

N70-20624# Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Physics Dept.
RADIATIVE X(0) DECAYS IN BROKEN SU(3)
Paul Singer Sep. 1969 8 p refs
(DESY-69/35) Avail: CFSTI

The radiative decays of the X(0) meson are analyzed in the framework of an effective Lagrangian with vector-meson dominance, using vector gauge fields with current mixing and assuming X(0) to be a unitary singlet. The underlying VVP strong interaction obeys octet-broken SU(3) symmetry. The model is shown to predict branching ratios different from those obtained in the eta-X(0) mixing model. An analysis of the experimental situation is presented and the relevance of the X(0) yields 2 gammas, X(0) yields omega gamma partial decay modes for distinguishing between different theoretical models is pointed out. Author (NSA)

N70-20634# Atomic Energy Commission, Washington, D.C.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY COMMITTEE

M. S. Moore, comp. (Los Alamos Sci. Lab.) 1969 510 p refs Meeting held at Oak Ridge, Tenn., 15-17 Apr. 1969
(EANDC(US)-120-U; INDC-US)-10-U; WASH-1127) Avail: CFSTI

Eighteen reports submitted to the AEC Nuclear Cross Sections Advisory Committee are presented. The work covered microscopic neutron cross sections, charged particle cross sections, and gamma-ray production by nuclear reactions or radioactive decay. NSA

N70-20648*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
MOLECULAR COLLISIONS 12: GENERALIZED PHASE SHIFTS
C. F. Curtiss 20 Nov. 1969 33 p refs
(Grant NGL-50-002-001)
(NASA-CR-108944; WIS-TCI-370) Avail: CFSTI CSCL 20H

The previous development of the theory of rotational excitation in collisions of diatomic molecules is transformed to obtain equations for a set of generalized phase shifts. The resulting equations are in a form which may be interpreted in terms of trajectories and interference effects. Approximate equations valid in the semiclassical limit are obtained. A further approximation leads to the previously developed sudden approximation. Author

N70-20662# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
OPTICS AND NUCLEAR PHYSICS
I. M. Frank 1969 16 p refs In RUSSIAN
(JINR-P4-4646) Avail: CFSTI

The dependence of the radiation of a fast particle moving in a medium on the optical properties of this medium is considered. More emphasis is placed on the transition radiation of a relativistic particle and on the scattering of light by a relativistic electron in a medium. Author (NSA)

N70-20668# Nebraska Univ., Lincoln. Behlen Lab. of Physics.
PARTICLE TRACKS IN EMULSION AND RELATED PHENOMENA
Robert Katz and E. J. Kobetich [1968] 37 p refs Presented at the NAS-NRC Symp., 1 May 1969 Sponsored by AEC and NSF
(COO-1671-16; CONF-690422-2) Avail: CFSTI

The structure of particle tracks in emulsion may be understood through the spatial distribution of ionization energy carried into the medium by delta rays, through an analysis used earlier to find the cross section for inactivation of dry enzymes and viruses, and the response of NaI(Tl) to heavy ions. A parallel analysis yields criteria for the production of etchable tracks in dielectrics. The assumption that emulsion responds to a 1-hit process to the mean energy dose deposited in an emulsion grain yields predictions of grain count, the blackness profile, and the width of heavy ion tracks in emulsion. Author (NSA)

N70-20672# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
PHONON-ASSISTED CURRENT IN ORGANIC MOLECULAR CRYSTALS
P. Gosar and I. Vilfan Aug. 1969 15 p refs Submitted for publication
(IJS-R-564) Avail: CFSTI

It is shown that in organic molecular crystals, the fluctuations of the intermolecular electron jump frequencies from lattice vibrations, may produce a considerable increase of the total electric current. An expression for the current density operator is derived, and the corresponding linear response theory of the electrical conductivity is formulated. The phonon-assisted current can be partially accounted for by the proper corrections of the electron velocities used in a simple band theory calculation. These corrections are explicitly calculated for a three dimensional parabolic and a one dimensional narrow electron energy band. Author

N70-20745*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
NEW PARTITIONING PERTURBATION THEORY. 1: GENERAL FORMALISM
Phillip R. Certain and Joseph O. Hirschfelder 20 Nov. 1969 43 p refs
(Grant NGL-50-002-001)
(NASA-CR-108928; WIS-TCI-365) Avail: CFSTI CSCL 20H

By the use of partitioning techniques, a general formalism is developed for considering degenerate, almost degenerate, and electron exchange perturbation problems. The Van Vleck-Kirtman approach to arbitrary orders and arbitrary normalization is generalized and three types of approximations are obtained. In the modified Kirtman treatment the functions through the N-th order are fully normalized and the energy is obtained as the roots of the secular equation. The DE-FOP-VIM approximation is the same except that the normalization of the functions is energy optimized. The Kirtman approximation uses the same functions as the modified Kirtman but the energy is obtained as the roots of a much simpler secular equation which results from a factorization of the original secular equation. Author

N70-20746*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
NEW PARTITIONING PERTURBATION THEORY. 2: EXAMPLE OF ALMOST DEGENERACY
Phillip R. Certain, David R. Dion, and Joseph O. Hirschfelder 24 Nov. 1969 19 p refs
(Grant NGL-50-002-001)
(NASA-CR-108923; WIS-TCI-368) Avail: CFSTI CSCL 20H

A system of two coupled simple harmonic oscillators where many of the energy levels are almost degenerate doublets provides a means for testing many perturbation techniques including the modified Kirtman, Kirtman, and DE-FOP-VIM treatments. These methods are compared with the "usual" approach to almost degenerate problems which makes the zeroth order energies of the doublet pair degenerate by a suitable choice of the zeroth order hamiltonian. In addition, four types of Rayleigh-Schrödinger expansions are considered. The best values of the energy are given by the Kirtman treatment. However, the DE-FOP-VIM and the modified Kirtman procedures give values almost as good, and have the added advantage that they give upper bounds to the energy of the states which are considered. Author

N70-20747*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
NEW PARTITIONING PERTURBATION THEORY. 3: APPLICATIONS TO ELECTRON EXCHANGE
Phillip R. Certain and Joseph C. Hirschfelder 28 Nov. 1969 28 p refs
(Grant NGL-50-002-001)
(NASA-CR-108931; WIS-TCI-367) Avail: CFSTI CSCL 20H

A partitioning perturbation technique provides a rigorous derivation and generalization of the Hirschfelder-Silbey formalism for treating electron exchange problems. A method of solving the first order perturbation equation is introduced. The first order wave function is the sum of the polarization function which describes van der Waals correlations and an exchange function which introduces ionic terms. The exchange function is determined variationally for both the ground state H + H(+) and H + H interactions. In the many electron case, the first order equation reduces to a set of one and two electron equations. Author

N70-20801# Tokyo Univ. (Japan). Inst. for Nuclear Study.
ACHROMATIC BEAM TRANSPORT SYSTEMS USING AN ELECTRIC FIELD AND A MAGNETIC FIELD
Tatsuoki Takeda and Tatsuo Arikawa Mar. 1969 19 p refs
(SJC-A-69-1) Avail: CFSTI

Achromatic beam transport systems using an electric field

and a magnetic field are studied. It is concluded that a quadrupole lens, a bending magnet and a dc separator can be made achromatic or dispersionless, especially for low or intermediate momentum particles by this method. Author (NSA)

N70-20802# Osaka Univ. (Japan). Lab. of Nuclear Studies.
STROBOSCOPIC OBSERVATION OF LARMOR PRECESSION IN NUCLEAR EXCITED STATES
Shoji Nagamiya and Kenzo Sugimoto 30 Apr. 1969 26 p
(OULNS-69-3) Avail: CFSTI

A new simple method of accurately determining the g-factor of nuclear excited levels is studied. The method is named the stroboscopic method because its principle is similar to that of the stroboscope. The formula for the expected line shape is derived. The influence on the line shape arising from (1) width of beam pulse, (2) spread of observation time, and (3) irregularity in beam repetition time is discussed. A computer program is presented by which one may calculate the expected line shape. Author (NSA)

N70-20834# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
PROPERTIES OF SOME EXCITED STATES IN Cl 35
M. Kregar, P. Kump, V. Ramsak, M. Vakselj, M. Zupan et al Jul. 1969 12 p refs Submitted for publication
(IJS-R-563) Avail: CFSTI

The gamma decay of S-34(p,gamma)Cl-35 resonances at 1016, 1211, 1222, 1264, 1510, and 1550 keV was investigated with NaI(Tl) and Ge(Li) detectors. Using the gamma-ray Doppler shift method, the mean lifetimes of nuclear bound states were found. The results are discussed and compared with published data. Author

N70-20839# California Univ., Berkeley. Lawrence Radiation Lab.
A STUDY OF THE REACTION PION(+) d YIELDS (p) p PION(+) PION (-) PION (O) AT INCIDENT PION MOMENTA BETWEEN 1.1 AND 2.4 GeV/c
Jerome Samuel Danburg (Ph.D. Thesis) Jul. 1969 167 p refs
(Contract W-7405-eng-48)
(UCRL-19275) Avail: CFSTI

The reaction was studied in a 264,000-picture bubble chamber experiment with pion beam momentum between 1.1 and 2.4 BeV/c. The most significant features of the final state are production of eta and omega mesons in the reactions pion(+) neutron yields eta proton, and pion (+) proton yields omega proton. The eta production characteristics are well described by a Reggeized A sub 2-exchange model using Veneziano-type residue functions. The omega meson production and decay characteristics are presented, and it is found that a rho-exchange model with absorptive corrections is inadequate to describe the data. Author (NSA)

N70-20848# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
EXPERIMENTAL INVESTIGATION OF THE n-p AND p-p FINAL STATE INTERACTION IN THE THREE BODY REACTION p PLUS d YIELDS p PLUS p PLUS n WITH 52-MEV DEUTERONS
H. Brueckmann, W. Gehrke, W. Kluge, H. Matthaey, L. Schaenzler et al Jul. 1969 18 p refs Presented at the Intern. Conf. on the Three-Body Probl., Birmingham, England
(KFK-1012; CONF-690710-3) Avail: CFSTI

The reaction deuteron + proton yields proton + proton + neutron was studied in kinematically complete experiments at a deuteron bombarding energy of 52 MeV. Two of the outgoing nucleons (two protons or the neutron and one of the protons) were detected in coincidence. The reaction was investigated at different sets of angles where a neutron + proton respectively a proton + proton final state interaction is expected to be the dominating reaction mechanism. The neutron + proton final state interaction data were analyzed assuming incoherent contributions of a neutron + proton singlet and a neutron + proton triplet final state interaction. Three independent parameters, the singlet scattering length and the two intensities for singlet and triplet scattering were determined by a least square fit to the experimental data. The results for different center of mass angles of the third particle show the dominating singlet final-state interaction in the investigated kinematical region. A surprisingly fair agreement is obtained by comparing the data with calculations based on Watson's theory. Author (NSA)

N70-20883# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
MAKING A SOURCE OF IONS AT HIGH TEMPERATURE (2500 TO 3000 C) FOR THE ELECTROMAGNETIC SEPARATION OF ISOTOPES AT GRENOBLE [REALISATION D'UNE SOURCE D'IONS A HAUTE TEMPERATURE (2500-3000 C) POUR LE SEPARATEUR ELECTROMAGNETIQUE D'ISOTOPES DE GRENOBLE]
M. Bouriant, M. Boge, S. Deuseon, P. Griboval, and R. Bouchez Jun. 1969 10 p refs In FRENCH Presented at the Intern. Conf. on Ion Sources, Saclay, France, 18-20 Jun. 1969
(CEA-CONF-1303; CONF-690625-2) Avail: CFSTI

The ion source described was originally designed for the production of ion beams with necessary qualities for obtaining very enriched isotopes. The source permits two principal versions: either a cathode with direct heating, or a cathode with indirect heating. The choice is made depending upon the value of the vapor pressure of the ionizing element. The performance of the source is discussed in particular as a function of temperature. The ion source was adapted for the separation of the ions of fission products. However, it cannot be used for radioisotopes with a halflife of less than 1 hr. NSA

N70-20885# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
THE ELASTIC SCATTERING OF NEUTRONS WITH ENERGY 4 MeV IN SMALL ANGLES BY THE NUCLEI OF COPPER, INDIUM, TIN, LEAD, BISMUTH, AND URANIUM [UPRUGOE RASSEYANIE NEITRONOV S ENERGIEI 4 MEV NA MALVE UGLY YADRAMI MEDI, INDIYA, OLOVA, SVINTSA, VISMUTA I URANA]
G. V. Gorlov, N. S. Lebedeva, and V. M. Morozov 1968 20 p refs In RUSSIAN
(IAE-1653) Avail: CFSTI

Elastic scattering of polarized neutrons with 4 MeV at angles from 2 to 21 deg by Cu, In, Sn, Pb, Bi, and U nuclei was studied. It was found that the observed differential cross sections and polarization properties of the nuclei studied are well described, with the assumption of the existence of only nuclear or Coulomb (according to Schwinger) neutron scattering. Experimental values of differential and total cross sections were used for determining polarization properties of nuclei, differential cross sections of elastic scattering of unpolarized neutrons, and differential cross sections of nuclear forward elastic scattering. The magnitude of the polarization of neutrons in the D-D reaction was measured. Author (NSA)

N70-20899# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INELASTIC INTERACTIONS OF PIONS AND NUCLEONS WITH NUCLEI AT HIGH AND SUPER-HIGH ENERGIES (INTRANUCLEAR CASCADES, MULTIPLE-PARTICLE INTERACTIONS)
V. S. Barashenkov, K. K. Gudima, S. M. Eliseev, A. S. Iljinov, and V. D. Toneev 1969 27 p refs Presented at the 3d Intern. Conf. on High Energy Physics and Nuclear Structure, New York, 3-13 Sep. 1969
(JINR-E2-4607; CONF-690814-3) Avail: CFSTI

The mechanism of intranuclear cascades which is in good agreement with the presently available experimental data on inelastic pion- and nucleon-nucleus interactions in the whole energy range from a few dozens of MeV to a few GeV comes in

contradiction with them at higher energies. To eliminate these disagreements it is necessary to take into account many-particle interactions, production of resonons and changes in the nuclear matter density as the intranuclear cascade develops. The analysis of the experimental data is a unique possibility for investigating a new type of elementary particle interactions when in the initial state three, four or more particles (multiple particle interactions) rather than two, as is usually the case, are involved in the collision.
Author (NSA)

N70-20900# Tokyo Univ. (Japan). Inst. for Nuclear Study.
POSSIBLE MECHANISM OF DIRECT PRODUCTION OF MUON PAIRS AT HIGH ENERGIES
Satio Hayakana and Ken Kikuchi Nov. 1968 4 p refs
(SJC-P-68-6) Avail: CFSTI

It is pointed out that the production of muon pairs is inherent in high-energy nuclear interactions which take place through complex intermediate states called fire balls. The direct pair emission width and cross section are derived. The fire ball interactions are also caused from the nuclear interaction of the muon. The incident muon produces a fire ball which then decays into mesons. The cross section for this process is calculated.
NSA

N70-20903# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
AN EMPIRICAL METHOD FOR CALCULATION OF ENERGY DISTRIBUTION FOR CHARGED PARTICLES AFTER PASSAGE THROUGH AN ABSORBER [EINE EMPIRISCHE METHODE ZUR BESTIMMUNG DER VERTEILUNG DES ENERGIEVERLUSTES FUER IONISIERENDE TEILCHEN BEI DURCHGANG DURCH MATERIE]
Ch. Weddigen Apr. 1969 22 p refs In GERMAN; ENGLISH summary
(KFK-994) Avail: CFSTI

An empirical method for calculating energy distributions for charged particles after passage through an absorber is given. The method is based on the fact that range distributions are, within a few percent, gaussian shaped and that relative range straggling is practically independent of absorber material. Thus, by using graphs for particle range, differential energy loss, and relative range straggling energy distributions for small up to complete energy losses can be easily calculated. A brief historical review of theoretical and experimental work published on this subject is given. A description of the method is given and the influence of asymmetries in range distributions is discussed. It is shown that the method can be inverted in order to obtain range straggling from experimental results for energy straggling. Finally, formulas are given for correction with respect to experimental sources of error. The influence of reaction losses on energy distributions has not been taken into account.
Author (NSA)

N70-20905# Ceskoslovenka Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
ON TERMS USED IN THE PRODUCTION OF RADIOISOTOPES BY CHARGED PARTICLE BOMBARDMENT
K. Svoboda Aug. 1969 15 p refs Presented at Intern. Conf. on the Use of Cyclotrons in Chem. Met., and Biol., Oxford, 22-23 Sep. 1969 Submitted for publication
(UJV-2258-Ch; CONF-690924-1) Avail: CFSTI

Definitions used in connection with the production of radioisotopes by charged particle bombardment are discussed.
NSA

N70-20912# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
BASIC REQUIREMENTS OF ADVANCED NEUTRON DATA STORAGE AND RETRIEVAL SYSTEMS (CSISRS)
J. J. Schmidt Mar. 1969 46 p Presented at the IAEA Panel on Neutron Data Compilation, Upton, N.Y.
(EURFNR-665; KFK-941; EUR-4163; EANDC(E)-114(U); CONF-690204-2) Avail: CFSTI

Advanced data storage and retrieval systems under development like CSISRS could be useful, if not become indispensable for a large variety of users within the nuclear community ranging from evaluators and reactor physicists to basic nuclear physicists, if these systems provide certain basic requirements. Some ideas and proposals pertinent to this question are given from the view point of an evaluator's experience and needs. A first requirement concerns a clear definition of what quantities, to what extent, and in what form should be compiled and supplied by such a system. A second requirement, in view of the unreliability of the nuclear data basis, particularly for fast reactor design, becomes of most urgent importance at present and in the future and concerns the physical documentation of the compiled data, i.e., the clear and comprehensive indication of the experimental conditions for which the respective compiled data are valid.
Author (NSA)

N70-20913# Kernforschungszentrum, Karlsruhe (West Germany).
REAL TIME COMPUTATION OF CROSS CORRELATION FOR PSEUDORANDOM TIME-OF-FLIGHT EXPERIMENTS
G. Ehret, W. Glaeser, and J. Nehmer May 1969 14 p ref Presented at the Conf. on Computer Systems in Exptl. Nucl. Phys., Skytop, Pa.
(KFK-981; CONF-690301-7) Avail: CFSTI

The information attainable in time-of-flight experiments per unit time can be increased in many applications by pseudorandom pulsing, allowing a maximum duty cycle of 0.5. However, it is impossible to make any direct decision on the transfer function (the desired information) from the measured response function. If the necessary cross correlation calculations will be done on line the monitoring of the experiment and the application of a simple decision theory on its progress is possible. For 1,000 time channels typically 1,000,000 multiplications have to be made. The design and performance of a correlator system which is intended for thermal neutron spectroscopy using a Telefunken TR 86 computer is described.
Author (NSA)

N70-20919# Rutgers Univ., New Brunswick, N.J. Physics Dept.
S = 0 BARYON RESONANCES
Richard J. Plano Sep. 1969 63 p refs Presented at the Rapporteur's Rev. Talk for the Lund Intern. Conf. on Elementary Particles, 25 Jun. - 1 Jul. 1969 and presented at the Boulder Conf. on High Energy Phys., 18-22 Aug. 1969
Avail: CFSTI

The situation in S = 0 baryon resonances at the time of the Vienna Conference and the changes made since then are summarized. For the N*'s, the phase shift analysis of A. T. Lea and others has improved the certainty of the P13(1855), F17(1980), and D13(2030) and given evidence for slightly different masses as well as for a somewhat larger change in the mass of the G17(2190). These new mass values are probably more precise than the earlier values but, since they do not result from an overall fit, are perhaps most useful as an indication of the uncertainties. Further evidence was advanced for the decay of an N* near 1750 MeV into Lambda K and the N*(3755) was very much weakened. For the delta's, the phase shift analysis has increased the probability of the D35(1950) and the P33(2030). The Delta(2420) and Delta(2850) are clearly seen in a backward charge exchange scattering experiment, a bubble chamber observation of the Delta(2850) has disappeared and the decays of two Delta++'s into the Delta++(1236) were observed. Improvements in technique are critically needed to produce the essential stream of precise and detailed data necessary to guide and restrain theoretical developments.
Author

N70-20935# Parke Mathematical Labs., Inc., Carlisle, Mass. Solid State Sciences Lab.
CLASSICAL THEORY OF ELECTRON SLOWING DOWN
Charles H. Sherman and Nan E. Gordon Sep. 1969 41 p refs
(Contract F19628-68-C-0188)

(AD-697832; AFCRL-69-0385; SR-2) Avail: CFSTI CSCL 7/4

Classical differential cross sections for electron-electron scattering are used to calculate the electron slowing down spectrum. The important feature of these cross sections is their inclusion of the motion of the bound electrons, which is an essential part of allowing for the binding. Some general aspects of the solution of the energy degradation equation are discussed, and numerical results are presented for some idealized problems. These results illustrate many features of the electron cascade that develops as fast electrons slow down. The results obtained by including the motion of the bound electrons are also compared with those which consider the bound electrons stationary. It is found that allowance for the motion of the bound electrons increases the flux at low energy. Author (TAB)

N70-20938# Tokyo Univ. (Japan). Inst. for Nuclear Study.

HAMILTONIAN FORMULATION OF NON-LINEAR BETATRON OSCILLATIONS IN A BEAM EJECTION SYSTEM OF AN AG SYNCHROTRON

Kazuo Huke Mar. 1968 7 p refs

(SJC-A-68-2) Avail: CFSTI

A time averaged Hamiltonian in a certain period is deduced from the motion of a non-linear betatron oscillation excited by many multipole magnets which are used in a resonant beam ejection system of an alternating-gradient synchrotron. NSA

N70-20978# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

ELECTROSTATIC FIELD OF EQUALLY CHARGED VOLUMES WITH CYLINDRICAL CONFIGURATIONS

V. I. Danilov et al Aug. 1969 22 p refs Transl. into ENGLISH from Russian report JINR-P-2131

(UB/Trans-205; JINR-P-2131) Avail: CFSTI

The electrostatic field of a uniformly charged cylindrical configuration was calculated. The general case of these configurations is a part of a cylindrical ring with a central angle of 2 phi sub 0. The potential and the components of the field were determined with the aid of a specially constructed function U sub 0 satisfying the Laplace equation. Some particular cases of the general solution were considered: the electrostatic field of a cylindrical ring, of a sector, and of a cylinder with finite dimensions. Their limiting cases at semi-infinite and infinitely large height were considered. The results may be used to estimate the effect of the spatial charge of a bunch of accelerated particles on the stability of their motion. They may also help to calculate the maximum intensity attainable in different accelerators. Author (NSA)

N70-20984# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.

SPIN PRECESSION MAGNET FOR HIGH ENERGY NEUTRONS AND CHARGED PARTICLES [EIN SPINDREHMAGNET FUER HOCHENERGETISCHE NEUTRONEN UND GLADENE TEILCHEN]

H. Brueckmann, E. L. Haase, W. Kluge, and L. Schaenzler Nov. 1968 14 p refs In GERMAN; ENGLISH summary

(KFK-891) Avail: CFSTI

The method of spin rotation by means of a spin precession magnet has the advantage of eliminating instrumental asymmetries in polarization experiments. For such experiments at the Karlsruhe isochronous cyclotron a spin precession magnet was constructed, which is able to turn the spin of neutrons through 90 deg in either direction for energies up to 70 MeV. The magnet is a solenoid with a length of 2.48 m and with a maximum rating of (8.09 + or - 0.09) · 10 to the 5th power A turns. The solenoid is now in use for neutron polarization measurements, but it was found in experiments that this magnet is also suitable for spin precession of charged particles. Author (NSA)

N70-20990# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

SUBTRACTIVE FORMALISM IN THE QUANTUM ELECTRODYNAMICS

V. A. Scherbina 1969 86 p refs In RUSSIAN; ENGLISH summary Presented at the 3d Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev, Apr. 1969

(ITF-69-36; CONF-690417-19) Avail: CFSTI

There is constructed the sequence of nonlocal bounded self-adjoint interaction Hamiltonians formally amounting to the renormalized Hamiltonian of the quantum electrodynamics. A special boundary transition rigorously resolves itself into the principal results of previous local theory. Author (NSA)

N70-20991# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

INVESTIGATION OF THE PROPERTIES OF THE NEUTRON DEFICIENT CESIUM NUCLEI. PART 3: AN ISOMERIC STATE IN Cs 123

Ch. Droste, W. Noubert, T. Morek, Z. Wilhelmi, S. Chojnacki et al 1969 13 p refs In RUSSIAN

(JINR-P6-4592) Avail: CFSTI

A new isomeric state with gamma-transitions of 63 and 95 keV was found in Cs-123. Multipolarities of both the transitions were determined: M1 + E2 or E2. The half life is T sub 1/2 = 1.60 + or - 0.15 sec. The isomeric state was exited in the reactions In-115(C-12,4n)Cs-123 and Ag-109(O-18,4n)Cs-123. Author (NSA)

N70-20992# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

INVESTIGATION OF THE PROPERTIES OF THE NEUTRON DEFICIENT CESIUM NUCLEI. PART 1: NEW ISOTOPES Cs 122 AND Cs 124

Ch. Droste, W. Noubert, T. Morek, S. Chojnacki, Z. Wilhelmi et al 1969 17 p refs In RUSSIAN

(JINR-P6-4539) Avail: CFSTI

The beta(+) decay of Cs-122 and Cs-124 was investigated. The isotopes were produced in the reaction In-113(C-12,3n)Cs-122, Ag-109(O-12,5n)Cs-122 and In-115(C-12,3n)Cs-124, respectively. The half life of Cs-122 is 23 + or - 6 sec and of Cs-124 is 34 + or - 6 sec. The spin and parity of the ground state of Cs-124 are I-pi = 1(+). Author (NSA)

N70-20994# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.

STATISTICAL BEAM MODULATION TECHNIQUES IN NEUTRON PHYSICS

K. H. Beckurts Mar. 1969 16 p refs

(KFK-946) Avail: CFSTI

Three basic methods are described by which time-of-flight distributions can be measured. The first is to excite a system by short pulses and to observe directly the system response function. The second possibility is to excite the system by a sine wave; then the output yields the Fourier transform of the response function. Finally, it is possible to excite the system by white noise and to form a cross-correlation between input and output. Since the autocorrelation function of a white noise signal is a delta function in time, the output of the cross-correlation process will be the impulse response function. The first method is employed in classical TOF experiments. It is shown that both the second and third methods can be used with neutrons. However, the correlation method is concentrated on. NSA

N70-21004# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.

PRODUCTION OF A POLARIZED DEUTERON BEAM FROM HYDROGEN ATOMS IN METASTABLE 2S 1/2 CONDITION

[ERZEGUNG EINES POLARISIERTEN DEUTERONENSTRAHLS AUS WASSERSTOFFATOMEN IM METASTABILEN 2 S 1/2-ZUSTAND]
V. Bechtold, H. Brueckmann, D.Finken, L. Friedrich, K. Hamdi, et al Apr. 1969 28 p refs In GERMAN; ENGLISH summary Presented at Spring Conf. of the Comm. on Nucl. Phys. of the Ger. Phys. Soc., Freudenstadt, West Ger., 24-28 Mar. 1969
(KFK-982; Conf-690326-1) Avail: CFSTI

For the production of polarized hydrogen or deuterium ions beams a method that makes use of the different lifetimes of the metastable state of the hydrogen atom (Lamb-shift source) was studied. This method has the advantage of producing intense negative ion beams having a high density of particles in the phase-space volume. The tensor polarization was obtained by neutron asymmetry measurement with the T(d,n)He-4 reaction. The polarization can be predicted from the experimental values for the ion beam intensities. Investigations of the beam emittance and acceptance were carried out to optimize the ion optic of the primary proton or deuteron beam. With an improved electrostatic lens system a beam intensity of 150 nA negative deuteron ions was achieved. Polarzied positive deuteron beams were produced by charge exchange of polarized metastable D(2S) atoms with hydrogen, deuterium, and helium. The quenching rate was investigated as a function of beam energy.
Author (NSA)

N70-21068# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
APPLICATION OF A REGGEIZED MULTI-PERIPHERAL MODEL TO NEGATIVE PION p INTERACTION AT 11 GeV/c
C. Caso, F. Conte, G. Tomasini, E. Bassler, D. Cords et al Sep. 1969 38 p refs
(DESY-69/37) Avail: CFSTI

The modified multi-Regge model is used to calculate one-particle distributions of transverse and longitudinal momenta and invariant mass distributions of the reactions pion(-) p yields N+(n-1) pion with multiplicities n ranging from 3 to 7 and an incident momentum of 11 GeV/c. The model is applied in a way that allows one to distinguish between differently charged pions. In order to account for the experimentally observed neutral pions in the forward direction, one must take for the trajectory with G-parity + 1 the rho and not the Pomeron used by CLA. A comparison between the multi-Regge calculations and the experiment shows a good overall agreement.
Author (NSA)

N70-21074# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
COLLISIONAL DISSOCIATION OF HYDROCARBON IONS
J. Guidini, A. Julienne, M. Roussel, and F. P. G. Valckx [1968] 13 p refs In FRENCH Presented at the 3d Nat. Conf. on Electronics and Atomic Collisions, Toulouse, 14-16 Apr. 1969
(CEA-CONF-1292; CONF-690428-1) Avail: CFSTI

A primary ion beam of CH sub n(+) with n varying from 1 to 5) was accelerated between 40 and 50 kV on to a hydrogen target. The reactions produced are exoenergetic and the separation energy is transformed into kinetic energy distributed among the dissociation products. The energy spectra of H2(0), H(0), H(+) and H2(+) were measured and the effective cross sections for the formation of H(0) and H2(0) from CH4(+) and CH3(+) were estimated.
Author (NSA)

N70-21078# Columbia Univ., Irvington, N.Y. Nevis Labs.
THE PION(+) PROTON INTERACTION AT 8.5 GeV/c
Husi Han Kung (Ph.D. Thesis) Apr. 1969 69 p refs
(Contract AT(30-1)-1932)
(NEVIS-171; CU-275; R-667) Avail: CFSTI

A total of 60,000 pictures, with incident pion(+) at the momentum of 8.49 GeV/c, were obtained from an 80-in. hydrogen bubble chamber. The study pertains to resonance production in the proton multipion final states. A total of 18,000 4-prong events, 6,500 6-prong events, and 500 8-prong events were measured and fitted to proton plus n-pion final states, n ranging from 3 to 8. The information obtained shows strong production of N*(++)(1238) and other pionic resonances such as rho(0), omega(0), eta(0), etc. in the 4- and 5-body final states, and that such reactions were essentially peripheral, i.e., with very low delta squared (defined as the negative of the 4-momenta transfer square to the proton). The cross sections for various channels are given and fraction of resonance productions, notably N*(++), rho(0), omega(0), etc. are also included. The observation of A2(0) in the channel pion(+)+p yields N*(++) + A2(0) yields pion (+) + p + pion(+) + pion(-) + pion(0) is discussed in some detail.
Author (NSA)

N70-21094# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.
IBM 1800 PROGRAMS FOR DATA PROCESSING AT THE ACCELERATORS OF THE CENTRAL BUREAU FOR NUCLEAR MEASUREMENTS. PART 1: OFF-LINE PROGRAMS FOR DATA HANDLING AND REDUCTION
H. Schmid, H. Horstmann, and H. Claessens (IBM, Belgium) 1969 244 p refs
(EUR-4404.E-Pt-1) Avail: CFSTI

A set of IBM 1800 programs for data handling and reduction at the Van de Graaff and the electron linear accelerator is described. Most of the data to be processed are neutron cross section data collected in time-of-flight multi-channel analysers. These data are either buffered on magnetic tape (off-line operation) or directly transferred to the computer and stored on disk (on-line operation). The program package described contains programs for checking the analyzer data on magnetic tape, conversion of analyzer spectra (tape to card, printer, and plotter; card to tape and disk; disk to card, printer, and plotter), and summing of analyzer spectra, especially for data reduction of transmission measurements. Almost all programs are written in ASSEMBLER language for the Time-Sharing Executive System (TSX).
Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-19710*# Illinois Univ., Urbana. Antenna Lab.
IMPEDANCE OF CYLINDRICAL ANTENNAS IN PLASMA: A REVIEW
S. W. Lee and M. J. Al-Hakkak Jan. 1970 167 p refs
(Grant NGR-14-005-009)
(NASA-CR-108234; Rept-70-3; SR-13) Avail: CFSTI CSCL 20I

Solutions are derived for the impedance of cylindrical antennas in a linear cold or warm plasma, with the assumption that the plasma models used are of infinite extent and homogeneous. The sheath effect of plasma on antennas is considered for laboratory conditions and in the ionosphere. A bibliography is given of various electromagnetic sources located in a plasma.
R.B.

N70-19732# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Status Report, 1 Feb.-31 Jul. 1969
Aug. 1969 57 p refs
(Contract AT(04-3)-326)
(SU-IPR-336; SR-34) Avail: CFSTI

Current activities include the following topics: (a) Low frequency ion-acoustic and drift waves on the positive column in a magnetic field. An rf perturbation theory based on a self-consistent solution for the steady state column has been derived, and is being tested experimentally. (b) Electron cyclotron echoes. Response of a magnetoplasma to short pulses at the cyclotron frequency is being studied. The detailed physical description of the phenomena involved permits the development of techniques for plasma density measurement and determination of collision data. (c) Beam/plasma

interaction. Aspects of this phenomenon currently being studied are the effects on the interaction of inhomogeneity, beam and plasma temperature, and bounded beam and plasma geometry. (d) Wave/wave interactions. Basic equations of small signal plasma wave theory may now be considered to have been well verified experimentally, and higher order approximations can be attempted. Work in this direction concerns the nonlinear coupling of cyclotron harmonic waves, Langmuir waves, and whistlers. Author (NSA)

N70-19733# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
REPORT OF ACTIVITIES OF THE RESEARCH GROUP, 1 JANUARY 1968-31 MARCH 1969
31 Mar. 1969 243 p refs In FRENCH
(EUR-CEA-FC-518) Avail: AEC Depository Libraries

The theoretical and experimental studies on fusion devices made in 1967 are reported. The theoretical studies considered MHD confinement and stability, microinstabilities in waves, and study of the spectral rays emitted by plasma. The experimental study on the accumulation and confinement of plasma was continued on open configurations, closed configurations, and formation of plasmas. The experimental results obtained from the bille-en-tete and Deca IIB are reported. The closed configuration machines Stator and Harmonica were both extensively modified during the year and the experimental results obtained with these modified instruments are reported. The properties of superconductivity devices used in the fusion devices are described. Studies made to improve the coordination and efficiency of studies in plasma physics are reported. These include studies of the interaction of radiation with matter, spectronomy of dense plasmas, nonlinear propagation and interaction of electromagnetic waves, plasma electron waves, waves and interactions of electron beams, derivative waves due to the pressure gradient, and fluctuations in plasma. NSA

N70-19751# Nagoya Univ. (Japan). Inst. of Plasma Physics.
HARMONIC GENERATION BY LANDAU-DAMPED ION ACOUSTIC WAVES IN A PLASMA
Noriyoshi Sato (Tohoku Univ. Sendai, Japan) Nov. 1969 10 p refs
(IPPJ-83) Avail: CFSTI

An experiment is made on harmonics generated by two Landau-damped ion acoustic waves in a plasma. The results are in qualitative agreement with simple physical predictions. Author

N70-19755# Texas Univ., Dallas.
DIRECT MEASUREMENT OF THE DEPENDENCE ON ELECTRON DENSITY OF THE RECOMBINATION RATE COEFFICIENT OF He2(+) WITH ELECTRONS IN A HIGH PRESSURE HELIUM PLASMA
C. B. Collins, H. S. Hicks, and W. E. Wells Feb. 1970 31 p refs Submitted for publication
(Grant NSF-GA-15434)
(SP-70-002) Avail: Issuing Activity

A computer-linked spectroscopic system with a high sensitivity-resolution product is used to measure the time dependent, net rate of production of neutral helium molecules resulting from the recombination of He-2(+) with electrons in a pulsed helium afterglow at a neutral pressure of 44.6 torr. The relative recombination rate coefficient of He-2(+) as a function of afterglow time is obtained by dividing this data by the unscaled product of the electron and molecular ion density as determined from levels in Saha equilibrium with the free electrons. Simultaneous measurement of the electron density with a microwave interferometer gives the unscaled rate coefficient as a continuous function of electron density without the need of a priori assumptions about the functional form. Scale is established through integration of the rate equation for the loss of ions. Author

N70-19763# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ENERGY ANALYSER IN THE AXIAL MAGNETIC FIELD FOR HOT ELECTRONS EMITTED FROM PLASMAS
Sunao Kawasaki Nov. 1969 29 p refs
(IPPJ-84) Avail: CFSTI

Two new modifications of the energy selective analyser working in an axial magnetic field and with a perpendicular electric field are proposed. Their characteristics are discussed in view of application for the plasma diagnostics, especially for the energy measurement of the particles escaping from a linear system. The energy resolution of one of them is calculated in detail and one design of the analyser with the multichannel detectors is shown. A brief description of its construction and a preliminary result of the calibration is also given. Author

N70-19764# Nagoya Univ. (Japan). Inst. of Plasma Physics.
END LOSS FROM A MIRROR MACHINE BY THE INTERACTION WITH RESIDUAL GASES
Sunao Kawasaki Nov. 1969 33 p refs
(IPPJ-85) Avail: CFSTI

End loss of a hot electron plasma from a mirror machine caused by the interaction with residual gases is analysed by resolving the Boltzman equation for the diffusion process in a velocity space into the loss cone. The equation is treated in a general way for an arbitrary scattering function and the inelastic scattering of the particle and the resulting energy loss are taken into account. The predicted energy distribution of escaping particles, the e-folding time of the confined plasma and the time evolution of the anisotropy in velocity space are compared with the experimental results in another system in a good agreement and the mechanism of the end loss in this system is well identified. Author

N70-19765# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NONLINEAR BEHAVIORS OF WAVES IN A PLASMA IN THE VICINITY OF MARGINALLY STABLE STATE
Yukio Midzuno and Tsuguhiro Watanabe Nov. 1969 35 p refs Submitted for publication
(IPPJ-86) Avail: CFSTI

Nonlinear behaviors of monochromatic travelling waves are discussed by the use of an asymptotic method. The wave is assumed to be stationary in the first approximation and nonlinear interaction are taken into account only among the wave under consideration and its harmonics. It is shown that two cases should be distinguished according as the frequency of the wave in the first approximation is given by a simple root or a double root of the dispersion relation. Characteristic behaviors of the wave in the latter case are studied by discussing a model equation and a special case of two beam instability. The behaviors of the complex amplitude of the wave are visualized in the form of a motion of a particle in an axisymmetric potential. Author

N70-19813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULATION OF THE FOKKER-PLANCK EQUATION BY RANDOM WALKS OF TEST PARTICLES IN VELOCITY SPACE WITH APPLICATION TO MAGNETIC MIRROR SYSTEMS
Gerald W. Englert Washington Feb. 1970 77 p refs
(NASA-TN-D-5671; E-5165) Avail: CFSTI CSCL 20I

The structure of an analytical expression obtained from a random-walk process was compared with that of the Fokker-Planck equation. The step sizes and probabilities of taking steps in various directions were related to the coefficients of the Fokker-Planck equation. Spherical coordinates with azimuthal symmetry about the polar axis were used. The technique was applied to a magnetic-mirror system for confining charged particles. The cases selected have approximate analytical solutions via the Fokker-Planck equation. Velocity distributions inside and end losses from this system were determined by the random-walk procedure and compared with results of the analytical solutions. Author

N70-19816# United Kingtom Atomic Energy Authority, Culham (England).
COLLISIONLESS INTERACTIONS IN INTERSTREAMING PLASMA JETS
P. E. Little, B. E. Avis, and R. B. Turner Apr. 1969 25 p refs
(CLM-R-99) Avail: CFSTI

The potential fluctuations detected by an external probe when two collision-free plasma jets stream through each each other in a magnetic field are described. The noise spectrum is enhanced in a frequency range where ions of one plasma are expected to generate noise by their interaction with the common electron cloud. This is the first experimental evidence for the existence of the ion-electron instability in interstreaming plasmas. The noise spectrum of a single plasma jet shows evidence of an instability driven by the perpendicular velocity of the ions which has been observed previously. Author (NSA)

N70-19840# United Kingdom Atomic Energy Authority, Culham (England).
THERMIONIC LITHIUM PLASMA SOURCE FOR DRIFT WAVE EXPERIMENTS
J. Burt, P. F. Little, and P. E. Stott Jan. 1969 15 p refs
(CLM-R-98) Avail: CFSTI

For experiments on drift waves in thermionic plasmas, it is important that the surface temperature of the ionizing plate should be carefully controlled in order to minimize the effects on the plasma of electric fields produced in the end plate sheaths. The ion Larmor radius may be made small by using a lithium plasma. Details are given of the design and construction of a source which has been used to produce a 5-cm-diameter column of lithium plasma at densities in the range 10 to the 7th to 10 to the 9th power/cu cm. Author (NSA)

N70-19914# United Kingdom Atomic Energy Authority, Culham (England).
ON STRONG TRANSVERSE MAGNETOGASDYNAMIC SHOCK WAVES
L. C. Woods May 1969 19 p refs
(CLM-R-96) Avail: CFSTI

The structure of strong transverse MHD shock waves was studied, using a two-fluid model. Thermoelectric effects and the temperature dependence of the transport coefficients are taken into account and a semi-empirical modification of the ionic transport coefficients that permits the ions almost collisionless behavior in the center of the shock is given. A detailed comparison between experiment and theory for shocks at Alfven Mach numbers of 2.5 and 3.7 is made. The main conclusion is that a theory that uses the usual or classical transport coefficients derived from kinetic theory, predicts shocks too thin by nearly an order of magnitude. To achieve the experimental thickness it is necessary to increase the classical resistivity about ten times, leaving the viscosity and thermal conductivities unchanged. An expression for anomalous resistivity, recently derived by the author from a temperature gradient instability, when used in place of the classical resistivity in the shock structure equations, yields profiles whose shape is in fair agreement with experiment. Author (NSA)

N70-19948# Brown Univ., Providence, R.I. Div. of Engineering.
ACCURACY OF DIFFERENTIAL APPROXIMATION FOR RADIATIVE IONIZATION IN COLD PRECURSOR OF AXISYMMETRIC DETACHED SHOCK
Anthony N. Pirri and Joseph H. Clark Sep. 1969 33 p refs
(Contract Nonr-562(35))
(AD-697974) Avail: CFSTI CSCL 20/9

Radiative ionization in the cold precursor of the shock preceding a blunt body immersed in a hypersonic monatomic gas flow is studied using the Milne-Eddington type differential approximation. In order to assess the accuracy of the differential approximation for a multidimensional, axisymmetric geometry, the results are compared with earlier work that presents an exact formulation. The precursor gas is non-emitting with a prescribed frequency dependent absorption coefficient, and the governing differential equation describing the radiation in the precursor is the (elliptic) Helmholtz equation; specification of the boundary conditions pose an interesting dilemma. An integral formulation is proposed and the resulting integral equation is solved to yield the spectral radiant energy density. Calculations of the volumetric photon absorption and the degree of ionization for argon in the near precursor are presented for a downstream degree of ionization on the stagnation streamline of 0.8, an upstream temperature of 300K, and an upstream pressure of .001 atm. The results are found to be sufficiently accurate for many purposes when the influenced point is only a few photon mean free paths from the surface and is close to the shock axis. Author (TAB)

N70-19953# Oak Ridge National Lab., Tenn.
STABILITY OF TOKAMAKS
Edward G. Harris 16 Oct. 1969 21 p refs Sponsored by AEC
(ORNL-TM-2766) Avail: CFSTI

Following a conjecture by Morse and Freidberg, the stability of the Bennett pinch was investigated with a magnetic field parallel to the axis. Under certain conditions all instabilities may be eliminated except for localized MHD instabilities near the axis. According to a modified form of the Suydam criterion derived, the MHD instabilities are eliminated when the cylindrical Bennett pinch is bent into a torus and the toroidal beta is less than (5/4) (r sub o/R) to the 2nd power, where r sub o is the mean radius of the pinch and R is the major radius of the torus. It is suggested that Tokamaks may operate in this stable regime. Author (NSA)

N70-20110# Sandia Corp., Albuquerque, N.Mex.
REFLECTION AND TRANSMISSION CHARACTERISTICS OF A PLASMA SLAB HAVING ARBITRARY ELECTRON DENSITY AND COLLISION FREQUENCY PROFILES USING THE METHOD OF INVARIANT IMBEDDING
Charles W. Harrison, Jr. 24 Apr. 1969 19 p refs
(SC-R-69-1368) Avail: CFSTI

It is shown that the transmission characteristics of the slab depend in a fundamental way on the reflection coefficient of the same model. The reflection coefficient satisfies the Riccati differential equation. Once the reflection coefficient is known for bounded media with or without internal discontinuities, transmission through the plasma may be obtained in a variety of ways. It is shown analytically that the general equations yield correct results when applied to the homogeneous plasma slab model. The differential equations obtained in this study may be integrated without difficulty to any desired degree of accuracy, using a computer. Author (NSA)

N70-20139# Sandia Corp., Albuquerque, N.Mex.
INTEGRAL FOR OBTAINING EXACTLY THE ELECTROMAGNETIC FIELD TRANSMITTED THROUGH A PLASMA SLAB HAVING SPECIFIED ELECTRON DENSITY-COLLISION FREQUENCY PROFILES
Charles W. Harrison, Jr. and David C. Chang (Colo. Univ., Boulder) 17 Jun. 1969 8 p refs
(SC-R-69-1369) Avail: CFSTI

The reflection coefficient of a nonhomogeneous plasma slab satisfies the Riccati differential equation. When the differential equation for the transmission coefficient is combined with the Riccati equation, the resulting expression is analytically integrable. It is demonstrated that transmission of an electromagnetic field through the slab may be expressed entirely in terms of an integral involving the complex wave number and reflection coefficient of the medium. It is shown that the exact theory presented here yields correct results when used to obtain the transfer function for a homogeneous imperfectly conducting sheet. Author (NSA)

N70-20145# Atomic Energy Commission, Washington, D.C. Div. of Research.

FUSION TORCH: CLOSING THE CYCLE FROM USE TO REUSE

Bernard J. Eastlund and William C. Gough 15 May 1969 25 p refs

(WASH-1132) Avail: SOD $0.35

Two concepts for the application of the ultrahigh-temperature plasmas now available in fusion experiments and eventually in controlled fusion reactors are discussed. The first concept is the use of ultrahigh-temperature plasma, in the form of a fusion torch, to reduce any material to its basic elements for separation. The second concept is the use of the fusion torch to transform the energy in the ultrahigh-temperature plasma into a radiation field, to permit process heating to be done in the body of a fluid. NSA

N70-20146# Academy of Sciences (USSR), Leningrad. Fiziko-Tekhnicheskii Inst.

LINEAR WAVE TRANSFORMATION IN AN INHOMOGENEOUS MAGNETOACTIVE PLASMA

A. D. Piliya and V. I. Fedorov 1968 18 p refs Transl. into ENGLISH from RUSSIAN Report No. FTI-144

(AEC-TR-7069) Avail: CFSTI

As is known, the electric field of a wave, being propagated in a cold plasma, whose concentration depends on a single coordinate x, has a peculiarity at the point where the tensor component of the dielectric penetrability goes to zero. The presence of this peculiarity leads to energy absorption of the wave, which does not disappear even in the absence of collisions. This absorption may be used for plasma heating. Experiments confirm the existence of the phenomenon. In this study the problem is solved for a moderately heated plasma, that is, with weak spatial dispersion being taken into account in order to estimate the practical possibilities of heating a plasma. It is shown that spatial dispersion leads to a situation where in place of energy absorption there takes place a transformation of the incident wave into a slow plasma wave. The energy carried by this plasma wave is equal to the energy absorbed in the cold plasma. NSA

N70-20273 Northwestern Univ., Evanston, Ill.

EXPERIMENTAL MEASUREMENT OF THE REFRACTIVE INDEX OF AN ARGON PLASMA AT LIGHT WAVELENGTHS OF 6328 ANGSTROM AND 1.15 Mu

William Frank Hug (Ph.D. Thesis) 1968 126 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-6942

A Mach-Zehnder interferometer has been used to measure the volumetric distribution of refractive index in an argon plasma at wavelengths of 6328A and 1.15 micron. These measurements were correlated with temperature, measured spectroscopically, from 11,000 K to 23,000 K at 1.10 atmospheres pressure. The argon plasma was generated using a free burning D.C. electric arc. The volumetric electron density distribution was inferred from the interferometric data assuming dispersion by free electrons only. Comparison of this data with the spectroscopically inferred electron density distribution is not favorable above 16,000 K. The absolute index of refraction was compared with existing theory and found to be in disagreement above about 15,000 K. The effective ionization limit inferred by a comparison of theory with experiment is in good agreement with some ionization limit theory. Dissert. Abstr.

N70-20282# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.

CHEMICAL AND ELECTRICAL EFFECTS OF PARIETAL INJECTIONS THROUGH A FLAT PLATE PLACED IN A PLASMA CURRENT [ETUDE DES EFFETS CHIMIQUES ET ELECTRIQUES D'UNE INJECTION PARIETALE A TRAVERS UNE PLAQUE PLANE PLACEE DANS UN COURANT DE PLASMA]

Bertrand Rowe and Gerard Lassau Nov. 1969 77 p refs In FRENCH

(Rept-69-4) Avail: CFSTI

An experimental study was made with the aid of a flat porous plate placed in a plasma jet of nitrogen or argon parallel to the jet axis, through which different or mixed gases were injected, to determine the effect of parietal injections. Results indicate that the effects are in the drop of the ionic concentration and that the injection of a polyatomic gas diminishes the heat transfer and the temperature in boundary layer according to the speed and energy dissociations of the gas. Emphasis is placed on obtaining the temperature profiles and the ionic concentration levels and comparing them with the theoretical results of thermal decomposition of the injected gas. Transl. by J.M.C.

N70-20294# Stichting Voor Fundamenteel Onderzoek Der Materie, Jutphaas (Netherlands). Inst. Voor Plasma-Fysica.

ELECTRON CONTAINMENT IN A CUSPED GEOMETRY

W. Strijland (Ph.D. Thesis - Univ. of Utrecht) May 1969 90 p refs

(NP-17974) Avail: AEC Depository Libraries

The accumulation of charged particles in a cusp magnetic field is studied. The magnetic configuration satisfies the conditions for magnetohydrodynamic stability, but the zero field point in the center makes the particle motion highly nonadiabatic. An experiment with electrons is compared with computer-calculated orbits and with theory on the average behavior of the particles. For the latter, it was assumed that the field consists of a central region which is fully randomizing and mirror regions where the magnetic moment is conserved. The electron experiment is partly a scale model of a large ion experiment and offers easy manageability because of the low electric and magnetic field strengths. The containment of the electrons was prolonged by closure of the mirror leaks with electrostatic fields. The containment was found to be limited only by collisions on the background neutrals. Numerical results are in accordance with a derivation that takes into account the geometry of the magnetic field and the particle density distribution. Author (NSA)

N70-20378# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

PECULIARITIES OF THE SHORTWAVE PART OF THE DOPPLER SPECTRUM IN A MEDIUM

I. M. Frank 1969 14 p refs In RUSSIAN

(JINR-P4-4647) Avail: CFSTI

The Doppler effect in a refractive medium is considered. Attention is focused on the peculiar features of the Doppler spectrum in the region of frequencies exceeding the plasma frequency of the medium. Author (NSA)

N70-20443*# Naval Ordnance Lab., White Oak, Md.

GAS OPACITY MEASUREMENTS WITH A BALLISTIC PISTON COMPRESSOR

G. T. Lalos and G. L. Hammond 21 Nov. 1969 50 p refs

(NASA Order C-77578)

(NASA-CR-72589; NOLTR-70-15) Avail: CFSTI CSCL 20I

The NOL Ballistic Piston Compressor was modified for opacity measurements in the ultraviolet between 1750 and 2500 A. Principal changes consisted of lengthening the compressor stroke to eight meters, use of a 4-port test section for simultaneous emission and absorption measurements, use of Suprasil and MgF2 windows and lenses, installation of a high intensity flashlamp, and use of high purity carrier gases. Opacity calculations using the best available literature values of photoabsorption cross sections predicted measurable opacity at wavelengths shorter than 2000 A for a 10% H2/90% He gas mixture at P = 2000 atmospheres and T = 5000 K. Results of control shot experiments with pure helium and with pure argon revealed anomalously high ultraviolet opacity, and prevented the projected hydrogen opacity measurements. Possible cause of the anomalous opacity are discussed and further steps that may be taken to reduce the impurity level are proposed. Author

N70-20496# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DENSITY MEASUREMENTS BY NONLINEAR INTERACTION OF ELECTROMAGNETIC WAVES IN A MAGNETIZED PLASMA
R. Cano, C. Etievant, I. Fidone, and B. Zanfagna [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest
(CEA-CONF-1392; CONF-690803-20) Avail: CFSTI

The results obtained on a low-density argon plasma in a constant magnetic field are presented. The values of the density obtained by this method are compared with those given by the well-known methods of linear propagation of waves. NSA

N70-20506# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
COLLISIONAL-RADIATIVE IONIZATION AND RECOMBINATION COEFFICIENTS FOR HELIUM PLASMAS
H. W. Drawin, F. Emard, and H. O. Tittel [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest
(CEA-CONF-1396; CONF-690803-22) Avail: CFSTI

The coefficients alpha (recombination)and S (ionization coefficient) have been calculated for a helium plasma covering the range from very low to very high densities. The singlet and the triplet system have simultaneously been taken into account, the coupling of the two-level systems accomplished by radiative processes (intercombination lines), electron collisions, and collisions with neutral atoms. NSA

N70-20582 National Lending Library for Science and Technology, Boston Spa (England).
THERMONUCLEAR SYSTEMS WITH DENSE PLASMA
A. I. Morozov 2 Jan. 1970 19 p refs Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 6, 1969 p 28-36
(NLL-CTO/686-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Systems for magnetic containment of plasma, in which the ratio of the plasma pressure to the magnetic pressure is approximately equal to or somewhat less than 1, are considered. Plasma formation is discussed, and cylindrical zeta and theta pinches, and noncylindrical zeta pinches are described. A method is outlined to increase the efficiency of a plasma accelerator by changing from a pulsed to a stationary discharge where the acceleration of the axisymmetric plasma flux towards the axis is continuous. Since the flux converges toward the axis, the device is called a magnetic plasma compressor. The design of a stable compressor is diagramed and studies on compressive flows are described. N.E.N.

N70-20587 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF THE ION TEMPERATURE IN TOKAMAK-3 FROM THE DOPPLER BROADENING OF THE SPECTRAL LINES OF NEUTRAL HYDROGEN AND DEUTERIUM
S. V. Mirnov et al 2 Jan. 1970 11 p refs Transl. into ENGLISH from I. V. Kurchatov Inst. Private Comm. (Moscow), Sep. 1969 p 1-7
(NLL-CTO/681-9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupon

Measurements are reported of the plasma ion temperature by a modified method compared to the optical method used for the determination of the ion temperature from the Doppler broadening of the spectral lines. The development is essentially that the necessary concentration of neutral atoms at the ion temperature is produced by charge exchange of deuterium plasma ions with a stream of hydrogen atoms injected by pulses during the discharge. The values for the ion temperatures are averaged over the column cross section; they lie in the range from 70 to 150 eV and, taking into account the assumed spatial distribution of the ion temperature, agree well with the results of ion temperature measurements from the spectrum of the neutral charge exchange atoms. Author

N70-20597# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
NON-MARKOVIAN IMPACT THEORY
Dietrich Voslamber [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug.-6 Sep. 1969
(CEA-CONF-1399; CONF-690803-30) Avail: CFSTI

A brief theoretical analysis that takes account of the non-Markovian character of the broadening process in plasma is presented. NSA

N70-20623# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
PLASMA WIND TUNNEL EXPERIMENT Topical Research Report, Apr.-Sep. 1969
W. W. Destler and D. L. Morse Oct. 1969 33 p refs
(Contract N00014-67-A-0077-0002)
(AD-697975; LPS-31) Avail: CFSTI CSCL 20/9

A plasma wind tunnel facility, similar to that described by Pugh and Patrick, is used to produce a super-Alfvenic flow of plasma over a magnetic obstacle for times approaching one millisecond. The flowing plasma has a density greater than 2 x 10 to the 13th power/cc on axis, and the density has decreased to one-half the peak value at a radius greater than 25 cm. The magnetic field embedded in the plasma stream is primarily axial and less than 30 gauss in magnitude. The magnetic field of the obstacle is essentially that of a single current-carrying conductor located on a diameter of the plasma stream cross section. The field of the obstacle is distorted by the plasma flow, and a narrow transition region forms in front of the obstacle. Preliminary investigations of the properties of the transition region are discussed. Author (TAB)

N70-20659# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
LiH LASER PRODUCED PLASMAS
M. Mattioli and D. Veron [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1390; CONF-690803-26) Avail: CFSTI

Measurements performed on plasmas produced by irradiating a pellet of LiH isolated in vacuum with a giant pulse laser are described. It is shown, by using a 1-nsec rise-time laser pulse, that the mean expansion velocity of the isotopic plasma is about 2 x 10 to the 7th power cm/sec, that is to say 4 times greater than that obtained with a 30-nsec laser pulse. With the fast rising pulse the total number of atoms reaching a sphere of 10-cm radius is equal to 20% of the atoms of the initial pellet, and the ions are multiply charged. By adding a magnetic field the ion-electron recombination is reduced, and the mean velocity of the protons reaches 5 x 10 to the 7th power cm/sec. NSA

N70-20681 National Lending Library for Science and Technology, Boston Spa (England).
LASER PRODUCED NEUTRONS
2 Jan. 1970 4 p Transl. into ENGLISH from Comm. Energie At. News Bull. (French), Sep. 1969 p 1-2
(NLL-CTO-678-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Plasma experiments with nuclear reactions directly induced by the laser beam were conducted. A Q-switched neodymium glass laser was focused on a solid deuterium target kept at -279 C by an optical system specially calculated to withstand the intense photon flux concentrated in a volume of a thousandth of a cubic millimeter. Time-of-flight measurements of observed neutrons confirmed that they were of an energy of 2.45 MeV produced by D-D fusion reactions in the hot plasma generated by the flux from the laser. This hypothesis was further confirmed when the plasma electron temperature was found to be between 7 and 10 million degrees. The results were obtained by a laser delivering a power of not more than 4 GW. D.L.G.

N70-20701# Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France).
IONIC TEMPERATURE MEASUREMENTS BY 90 DEG COOPERATIVE SCATTERING ON A PLASMA FOCUS
J. P. Baconnet, G. Cesari, A. Coudeville, and J. P. Watteau [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1374; CONF-690803-17) Avail: CFSTI

It is known that the plasma sheath reaches the axis when the current derivative is minimum. The present measurements are done 10 ns before that time when the ions heated by the shock wave have a temperature much higher than the electrons. Later in time the electrons are heated by the ions, the alpha value decreases, and the diffusion becomes only electronic. The spectrum is spread over a wavelength range and the signal-over-noise ratio becomes smaller than unity. Author (NSA)

N70-20702# Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France).
PLASMA FOCUS STRUCTURE FROM ONE NANOSECOND SCHLIEREN AND SHADOW PICTURES
J. P. Baconnet, G. Cesari, A. Coudeville, and J. P. Watteau [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1373; CONF-690803-16) Avail: CFSTI

Schlieren techniques have been used to study the structure of the plasma sheet produced by a coaxial plasma gun working in a focus regime. Preceding axial schlieren pictures are completed here by transverse ones and by shadowgrams to improve the spatial resolution; attempts are made to link the sheet aspect with the neutron yield. Author (NSA)

N70-20703# Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France).
TIME RESOLVED TEMPERATURE IN SOLID DEUTERIUM LASER PRODUCED PLASMAS
F. Floux, D. Cognard, and G. De Giovanni [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1372; CONF-690803-23) Avail: CFSTI

The X radiation from the laser-irradiated plasma passes through nickel or beryllium foils and is picked up by NE 102A plastic phosphors and 56 AVP Radiotechnique photomultipliers (rise time 2 ns). Time-resolved temperature diagrams are deduced from this data. NSA

N70-20704# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
LOW FREQUENCY DRIFT WAVES IN CYLINDRICAL GEOMETRY: EFFECT OF AN ELECTRIC FIELD AND IMPORTANCE OF THE DEBYE LENGTH
H. Luc [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug.-6 Sep. 1969
(CEA-CONF-1389; CONF-690803-25) Avail: CFSTI

The linear dispersion relation is established for low-frequency quasi-electrostatic waves in a collisionless plasma with a density gradient, in a strong homogeneous magnetic field, and in cylindrical geometries. The effect of a solid-body rotation of the plasma column, in the case of a very small Debye length, is considered. The effect of a finite Debye length in the absence of an electric field is considered next. NSA

N70-20775# Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France).
DENSITY PROFILE DETERMINATION IN A LASER CREATED PLASMA BY AN HOLOGRAPHIC METHOD
J. L. Bobin, J. C. Buges, P. Rouzaud, and A. Temesaud [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1375; CONF-690803-18) Avail: CFSTI

The experimental apparatus is described. A typical interferogram is given. Density profiles were determined from the interferogram and comparisons were made with previous data. NSA

N70-20777# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DENSITY PROFILE MEASUREMENT WITH THE PROPAGATION OF AN EXTRAORDINARY WAVE
P. A. Tulle [1969] 4 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1393; CONF-690803-29) Avail: CFSTI

These diagnostic methods require much shorter wavelengths than the cutoff of the ordinary mode. In comparison with ordinary interferometry, they give the radial repartition of density. By working with the second cutoff, one can extend the domain of utilization of the hyperfrequencies as regards the plasma density. Author (NSA)

N70-20794# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DETERMINATION OF PLASMA POTENTIAL USING AN EMISSIVE PROBE IN A MAGNETIC FIELD
P. Deschamps 1969 4 p refs Presented at the Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug. - 6 Sep. 1969
(CEA-CONF-1394; CONF-690803-21) Avail: CFSTI

The hypothesis that compares an emissive probe in a plasma to a diode with electrode spacing equalling the Debye length of the plasma seems justified. A special geometry of the probe and a detailed analysis of the emitted current allows one to directly determine the plasma potential in the presence of a magnetic field. The obtained values are practically the same as the values of probe potential where the cold probe characteristic exhibits an inflection point. This method applied to a quiescent plasma generated by an hf source shows that the static radial electric field within the density gradient is less than 1 V/cm. Author (NSA)

N70-20892 National Lending Library for Science and Technology, Boston Spa (England).
BEHAVIOUR OF A PLASMA PRODUCED BY OHMIC HEATING IN THE "OURAGAN" HIGH SHEAR STELLARATOR
V. N. Vishnevetskii et al 2 Jan. 1969 23 p refs Transl. into ENGLISH from FTI Rept. No. 69-48, p 1-20
(NLL-CTO/677-(9091.9F); FTI-69-48) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

The effects of shear on plasma energy and particle loss rates were studied in a stellarator high-shear closed-magnetic trap on a dense helium plasma. The following parameters were measured: (1) voltage at stellarator circumference; (2) discharge current; (3) electron temperature; (4) electron density; (5) radial plasma density distribution; and (6) fluctuations and distribution of probe saturation current and plasma potentials. Oscillations of spectral line intensities, of the gas, and impurities were also recorded. Results established the dependence of maximum discharge current on plasma parameters; a maximum current value was reached when plasma parameters were optimal as obtained by the mapping of the stellarator magnetic system by electron beam. Measurements of electron temperature and plasma density showed that as the thermal isolation of the plasma improved associated with its detachment from the limiter, the electron temperature increased and plasma density in time dropped off exponentially. G.G.

N70-21020# Princeton Univ., N.J. Plasma Physics Lab.
RESEARCH AND EXPERIMENTAL WORK Annual Report, 1 Jun. - 31 Dec. 1968
Mar. 1969 267 p refs
(Contract AT(30-1)-1238)
(MATT-Q-26) Avail: CFSTI

Progress is reported on the following: quadrupole and spherator experiments; stellarators; alkali plasma experiments; wave interactions; non-MHD instabilities; MHD equilibrium and stability; computer simulation and calculations; transport, diffusion, and kinetic theory; lasers, dynamics, and heating; astrophysical applications; electronics and instrumentation; magnetic field design; cryogenics; machines and systems; and fusion reactor studies. NSA

N70-21025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SURVEY OF PHENOMENA IN IONIZED GASES: SELECTED PAPERS
N. S. Buchelnikova et al 7 May 1969 60 p refs Transl. into ENGLISH from Intern. Conf. on Phenomena in Ionized Gases (Vienna), 1967 p 433-469
(AD-696498; FTD-MT-24-420-68) Avail: CFSTI

Contents: Study of instabilities in a thermally-ionized plasma; and Present state of research on plasma diffusion in a magnetic field. TAB

N70-21048# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
ENGINEERING ASPECTS OF ELECTROMAGNETIC ENERGY ADDITION TO A GAS BY A TRAVELING MAGNETIC FIELD Interim Report, Apr. 1968-Mar. 1969
Chalres W. Halderman and John Sullivan Sep. 1969 106 p refs
(Contract F33615-68-C-1380)
(AD-697405; ARL-69-0148) Avail: CFSTI CSCL 20/9

Research on a traveling wave plasma accelerator for ultimate use as a high altitude, high velocity flow simulation device is reported. The work reported covers: the design, construction and testing of acceleration coils for field levels up to 500,000 ampere turns per meter at 100 KHz; the predicted performance of increasing phase velocity accelerators using equilibrium air at these field levels, computed numerically from the one dimensional equations of motion including friction and heat transfer; analysis of a finite accelerator having a phase velocity which increases with length; a description of model accelerator coils with velocity ratio of 2.5; and methods of eliminating losses connected with the fringing field at the ends of an accelerator coil. Earlier calculations of the performance of an accelerator with a magnetic core are also extended, and experience with extension of the operating power level of the RF plasma source is briefly discussed. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-19712*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL AND OPTICAL PROPERTIES OF GALLIUM ARSENIDE Quarterly Progress Report, 1 Oct.-31 Dec. 1969
G. L. Pearson 31 Dec. 1969 6 p
(Grant NGL-05-020-043; Proj 5115)
(NASA-CR-108237) Avail: CFSTI CSCL 20L

Power rectifiers and solar batteries which will operate at temperatures up to 500 deg C are described. The melting temperatures of GaP-metal systems and the growth of GaP by vertical liquid epitaxy are discussed. A coaxial design is reported which is believed to offer distinct improvements over former methods. Author

N70-19713*# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.
OBSERVED INTERACTIONS OF THERMAL-ENERGY HELIUM AND ARGON ATOMS WITH VAPOR DEPOSITED SINGLE-CRYSTAL SILVER SURFACES
G. A. Pjura (M.S. Thesis) Sep. 1969 184 p refs
(Grants NGR-47-005-046; NsG-682)
(NASA-CR-108239; AEEP-4038-112-69U) Avail: CFSTI CSCL 20L

The possible presence of diffraction in the scattering of noble gases from silver crystals is investigated to provide velocity distribution data for the scattered beams. The process of growing a single crystal target surface and the design and construction of the deposition apparatus are described. The subsystems used in performing the actual scattering experiments and in evaluating the results are outlined, and the coordinate system is given in which the scattering data are plotted. R.B.

N70-19722 Maryland Univ., College Park.
MAGNETIC FIELD INDUCED SURFACE QUANTUM STATES IN SUPERCONDUCTING INDIUM
Juan Ramon Maldonado (Ph.D. Thesis) 1968 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-7635

When a magnetic field is applied parallel to the surface of a type I superconductor, surface states are induced within the penetration depth of the applied field. These states lie inside the superconducting energy gap and for T not equal to O are occupied by thermally excited quasiparticles. Transitions from these states into the BCS continuum, due to absorption of microwave photons by the quasiparticles, give rise to sharp peaks in the derivative of the resistive component of the surface impedance (dR/dH) as a function of H. Peaks in dR/dH in superconducting indium, tin and lead were observed. The amplitude of the peaks was found to decrease with decreasing temperature. The peak position was observed to vary with temperature as the reciprocal of the penetration depth calculated from the BCS theory. At a constant temperature, H sub p was observed to increase linearly with frequency from 10 GHz to 40 GHz. Dissert. Abstr.

N70-19728*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISM OF THE PHOTOVOLTAIC EFFECT IN 2-6 COMPOUNDS Progress Report, 1 Oct. -31 Dec. 1969
Richard H. Bube and P. F. Lindquist 31 Dec. 1969 23 p refs
(Grant NGL-05-020-214)
(NASA-CR-108241; PR-7) Avail: CFSTI CSCL 20L

The nature and interrelationship of electronic transitions involved in the photocapacitance effects at a Cu2S-CdS nonheated heterojunction were investigated in a detailed study of involving measurement of spectral response, optical quenching in different wavelength ranges, forward and reverse bias effects on quenching, and the influence of the photocapacitance on the short-circuit current, open-circuit voltage, and forward current of a photovoltaic cell. A persistent increase in capacitance of a Cu2S-CdS heterojunction occurs after photoexcitation at any temperature below room temperature. At 100 K, this persistent capitance increment can be as high as 50 percent of the value of the dark capacitance. This persistent capacitance can be quenched by heating, applying forward bias in the dark, or by irradiating with suitable wavelengths. The electronic transitions responsible for these effects are described in terms of a band diagram for the junction involving a narrow conduction band spike, a set of high-lying imperfection levels in the CdS at the junction, and a set of deep-lying imperfection levels in the CdS at the junction. Author

N70-19847*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISM OF THE PHOTOVOLTAIC EFFECT IN 2-6 COMPOUNDS Progress Report, 1 Jul. -30 Sep. 1969
Richard H. Bube, P. F. Lindquist, and K. Muray 30 Sep. 1969 8 p ref
(Grant NGR-05-020-214)
(NASA-CR-108242; PR-6) Avail: CFSTI CSCL 20L

Photocapacitance properties of a non-heat-treated Cu2S-CdS cell were investigated from the standpoint of expected correlation

between the states responsible for this effect and interface states responsible for the performance of the cell. Photocapacitance could be removed by: (1) heating the cell, (2) applying forward bias at low temperature in the dark, or (3) applying optical photons with energies between 1.2 and 1.8 eV to the cell at low temperature. The observed monotonic decrease in the photocapacitance with increasing temperature indicates that either a set of states with different depths is involved, or that the effective depth of a state depends on the total charge trapped. Removal of the photocapacitance by field or optical quenching may be the result either of removal of trapped holes or an increase in the density of trapped electrons near the junction. Exploratory research on the preparation of Cu2S-Cds heterojunctions under other than standard conditions is briefly described. Author

N70-19857*# Rice Univ., Houston, Tex.
RESEARCH ON THE PHYSICS OF SOLID MATERIALS
Semiannual Status Report, 1 Jan.-30 Jun. 1969
F. R. Brotzen, H. E. Rorschach, and M. L. Rudee 30 Jun. 1969 45 p refs
(Grant NGL-44-006-001)
(NASA-CR-108248; SASR-20) Avail: CFSTI CSCL 20L

The program in materials science, solid state physics and chemistry is presented. The research summaries are grouped in the following areas: mechanical properties and defect structure of solids, electrical and optical properties, magnetism and superconductivity, thermodynamics and solid surfaces, and thin magnetic films. F.O.S.

N70-19889 Washington Univ., Seattle.
FRACTURE INDUCED IN BICRYSTALS OF ALUMINUM OXIDE BY ANISOTROPIC THERMAL EXPANSION
Henry Y.B. Mar (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-7068

Bicrystals of aluminum oxide were vacuum-hot-pressed from optically flat sapphire slabs oriented with the c-axis lying in the mating face and an a-axis perpendicular to the mating face. When the c-axes twist in such bicrystals exceeded approximately 36 deg fracturing occurred. The fractures grew out from the bicrystal boundary and probably originated from Griffith flaws located in localized areas of high residual stress associated with pores. Ninety-degree-c-axis-twist bicrystals were treated as two-dimensional structures and analyzed with a computerized method of plane stress analysis. The analysis showed that 'principal-type' tensile stresses occur parallel to the c-axis directions and 'principal-type' compressive stresses occur perpendicular to the c-axis directions (in the plane of the bicrystal boundary). These stresses reached their maximum value in a localized region at the bicrystal boundary. Dissert. Abstr.

N70-20037 Case Western Reserve Univ., Cleveland, Ohio.
GROWTH OF DIAMOND SEED CRYSTALS BY VAPOR DEPOSITION
Herbert Allan Will (Ph.D. Thesis) 1968 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-9443

It was demonstrated that diamond can be grown by the decomposition of methane gas at 1050 C and 0.1 to 1.0 Torr in the presence of diamond seed crystals. The process yields both new diamond and graphite. The graphite was selectively removed by reaction with hydrogen at 1033 C and 50 atm. Repeated depositions on the same sample have produced total mass increases of up to 23.7%. The new diamond was identified by chemical analysis, chemical etching, density measurements, X-ray and electron diffraction, microwave absorption, electron spin resonance and visual observations. The crystalline quality of the new diamond has not been established; it could range from polycrystalline material with a large number of defects to true epitaxial diamond layers. Dissert. Abstr.

N70-20125 Northwestern Univ., Evanston, Ill.
NUCLEATION OF GOLD ON MUSCOVITE MICA
Winfred L. Morris, Jr. (Ph.D. Thesis) 1968 220 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 69-6967

In the initial stage of growth of deposit material on a substrate the deposit material is seen to group into clusters which grow independently on the substrate. Such nucleation arises from the random combination of single deposit atoms on the substrate subject to the interaction of deposit atoms with the substrate. The nucleation rate, the rate of formation of clusters per unit area per unit time, is related both to the nature of this interaction and to the substrate temperature and the deposit material flux. For a specific substrate temperature, nucleation is believed to occur upon small aggregates of deposit atoms containing a specific number of atoms. Thus, for a particular substrate temperature region it is expected that nucleation occurs upon stable pairs of atoms and in some higher substrate temperature region upon stable clusters of more than two atoms. Dissert. Abstr.

N70-20137 North Carolina State Coll., Raleigh.
A STUDY OF THE EFFECTS OF UNIAXIAL COMPRESSIVE STRESS ON MINORITY CARRIER LIFETIME IN SILICON AND GERMANIUM
Benjamin Johnston Sloan, Jr. (Ph.D. Thesis) 1968 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-7675

Photoconductive decay lifetime in thin filaments was measured as a function of temperature for uniaxial compressive stress. Measurements were made in n and p type silicon and germanium. Minority carrier bulk lifetime was observed to have increased or decreased by as much as 300 percent at stress levels of 10 to the 10th power dynes per sq cm. A model based on Shockley-Read statistics for recombination from multiple bands and through multiple recombination centers is used to explain the changes in lifetime with stress. The model is consistent with the experimental results and predicts changes in the recombination centers which are in substantial agreement with results obtained by other investigators. Dissert. Abstr.

N70-20197 New York Univ., N.Y.
CHARGE PRODUCTION, STORAGE WITHIN AND INJECTION INTO CADMIUM SULFIDE CRYSTALS
Stephen Mark Matthews (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-7979

The purpose of this work is to determine: the amount of positive and negative charges injected into a CdS crystal from various electrodes, the law of such injection, the free charges which are thermally produced in a crystal which has no electrodes, the charges which are trapped in the crystal during charge injection or charge production by light, the amount of charges produced by light in the crystal without electrodes, the influence of illumination or preceding illumination on charge injection, the amount of charges stored at a crystal-insulator surface and their rate of spontaneous decay, and to give a theoretical interpretation of the various processes. For these purposes insulating photo-conductive single crystal CdS platelets grown from the vapor phase are sandwiched between two sheets of plastic insulator, or between a metal electrode and one such sheet. Dissert. Abstr.

N70-20204 Rutgers Univ., New Brunswick, N.J.
THERMAL CONDUCTIVITY OF TYPE 2 SUPERCONDUCTORS NEAR THE UPPER CRITICAL FIELD
Leonard Vincent Delvecchio (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7531

The thermal conductivity of a number of InBi specimens was measured as a function of magnetic field and temperature

between .3 K and 4.2 K. The specimens had sufficient Bi concentration to make them type II superconductors. The thermal conductivity was measured in the mixed state primarily near the upper critical field. In this region the electronic thermal conductivity is expected to increase linearly with magnetic field, with a slope which has been calculated by Caroli and Cyrot. The experimental results are in very good agreement with the theory above a reduced temperature of 0.4. Below that temperature the experimental values of the slope are lower than the theoretical values by up to 30%. For the comparison with theory it was necessary to separate the electronic and lattice conductivities, and to analyze the lattice term into its contributions from the various scattering mechanisms. A correction could then be made for the field variation of the lattice conductivity. Dissert. Abstr.

N70-20220# Aerospace Corp., El Segundo, Calif. Lab. Operations.
STUDIES IN TANTALUM OXIDE CRYSTAL GROWTH, JANUARY-JUNE 1969
Gerard M. Wolten and Armand B. Chase 1 Oct. 1969 16 p refs
(Contract F04701-69-C-0066)
(AD-697961; TR-0066(5250-10)-2; SAMSO-TR-69-357) Avail: CFSTI CSCL 20/2

Crystals of beta- Ta2 O5 and gamma- Nb2 O5 have been grown from molten KPO3 and mixtures of KPO3 and KVO3. A search for additional polymorphs of beta- Ta2 O5 in this system has instead revealed five not hitherto reported tantalum compounds containing potassium or phosphorus or both and, in one case, vanadium. Author (TAB)

N70-20249 Stanford Univ., Calif.
SCATTERING OF ELECTRONIC EXCITATIONS BY VORTICES IN A CLEAN TYPE 2 SUPERCONDUCTOR
Robert Michael Cleary (Ph.D. Thesis) 1968 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-8164

Near the lower critical field Hcl, a type-2 superconductor is penetrated by a dilute array of quantized fluxoids. A formulation of the B.C.S. theory for such a superconductor is fairly straightforward but solution of the equations is a much more complicated task. In particular the theory has a self-consistency requirement for the pair potential coupling superconducting electrons and the magnetic vector potential of a vortex. Near the critical temperature however, the Ginzburg-Landau equations provide an easy access to these self-consistent potentials. The problem of superconducting electrons in the presence of a dilute and random array of vortices is formulated with the help of the temperature Green's function. The response of such a system to a long wavelength probe is not sensitive to the exact location of a given vortex and considerable simplification occurs if an average over their individual positions is taken. The resulting model is homogeneous but anisotropic. Dissert. Abstr.

N70-20263 Maryland Univ., College Park.
LASER EXCITED RAMAN SPECTROSCOPIC STUDIES OF SOLIDS: HIGH TEMPERATURE, HIGH PRESSURE PHASE TRANSITIONS AND ORIENTED SINGLE CRYSTALS
Alvin Joseph Melveger (Ph.D. Thesis) 1968 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-7637

The He-Ne and argon ion lasers were used to perform a variety of Raman spectroscopic studies on solid materials. A high temperature assembly was constructed to permit recording Raman spectra of materials at elevated temperature on the Cary 81 monochromator. Dissert. Abstr.

N70-20268 Syracuse Univ., N.Y.
MULTIPLE IMPACT IONIZATION IN P-TYPE INDIUM ANTIMONIDE
Sherman Leonard Golub (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-8626

A study was made of hot carrier transport processes in p-type Indium Antimonide at low temperatures. The term 'hot' is used to describe a carrier system in a state of higher average energy than at thermal equilibrium with the lattice. In the course of this work the previously unreported phenomenon of multiple impact ionization steps was observed. The effect is observed in uniform InSb doped with shallow acceptors, under conditions of temperature and doping level such that impurity banding controls the electrical conductivity and Hall effect. The description 'multiple steps' characterizes the time dependence of the current through a sample upon application of a constant electric field. For a sufficiently high field the current does not follow the field in a single step, but rather increases in time in a series of current steps. The model proposed is one of non-steady state runaway energy gain by the charge carriers under the action of the electric field. Dissert. Abstr.

N70-20357 Howard Univ., Washington, D.C.
A TWO COMPONENT X-RAY TECHNIQUE FOR THE PRECISION DETERMINATION OF LATTICE PARAMETERS AND THERMAL EXPANSION OF CeO2, He 2 O3, AND Lu 2 O3 AT LOW TEMPERATURE
Murari Lal Gupta (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-5738

Thermal expansion of the rare earth oxides was studied above room temperature by Campbell and Stecura, but no data are available to low temperatures. It is the purpose of this work to fill this gap for some of the oxides. The back-reflection patterns of cerium dioxide, holmium sesquioxide, and lutetium sesquioxide with the copper K alpha x-ray beam are sharp and intense and contain the K alpha-doublets. These oxides are studied with two component x-ray technique which consists of using the components of the K alpha x-radiation for computing the lattice parameters. In this way a knowledge of the distance between specimen and film or of the camera radius is not needed. Since the K alpha sub 1 and K alpha sub 2 diffraction lines are employed, this technique is called the two component x-ray technique. In comparing the room temperature lattice parameter values of these oxides with the other investigations, it is found that the present work is of the highest precision. The thermal expansion results are interpreted in terms of the Gruneisen theory. The compressibility data of these oxides are not available at any temperature; therefore, lambda for them cannot be computed. Dissert. Abstr.

N70-20369# South Dakota School of Mines and Technology, Rapid Physics Dept.
THERMAL CONDUCTIVITY MEASUREMENTS OF SEMICONDUCTORS Final Report, 1 Jul. 1969-31 Aug. 1969
Robert G. Morris and R. Daniel Redin 15 Nov. 1969 13 p refs
(Contract Nonr-2964(01))
(AD-698154; F2964) Avail: CFSTI CSCL 20/12

A brief summary of work accomplished in thermal conductivity measurements of Si, InSb, NaxW03, Bi2Te3, Bi8Te7S5, and Mg2Si above room temperature and Si, InSb, and EuO below room temperature is presented together with a list of publications and reports. Author (TAB)

N70-20409*# Brown Univ., Providence, R.I. Div. of Engineering.
INVESTIGATION OF THE EFFECTS OF SUB-THRESHOLD HIGH ENERGY ELECTRONS ON THE PROPERTIES OF SILICON PHOTOVOLTAIC CELLS Midway Report, 3 Feb.-3 Aug. 1969

J. J. Loferski and E. E. Crisman Sep. 1969 23 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-108906) Avail: CFSTI CSCL 20L

The effects of irradiating semiconductors by sub-threshold electrons is reviewed. It is pointed out that lithium atoms dissolved in silicon would be displaced by electrons whose energy is less than 35 keV, whereas the electron must have about 150 keV to displace a silicon atom. Experiments designed to test this phenomenon are described. The effects of electron irradiation on semiconductor surfaces are also reviewed. Experimental apparatus for investigation of the effects of electrons irradiation in organic vapor free vacua (like those of outer space) on the characteristics of silicon photovoltaic cells is described. Author

N70-20487# Arizona Univ., Tucson. Dept. of Physics.
PAIRING TREATMENT OF INTERACTING LOCALIZED MOMENTS IN DILUTE MAGNETIC ALLOYS
R. H. Parmenter 21 Nov. 1969 35 p refs
(Contract N00014-67-A-0209-0007)
(AD-698150; TR-3) Avail: CFSTI CSCL 20/12

The Anderson model of a localized magnetic center is used to study a system of interacting localized moments in a dilute magnetic alloy. The effective interaction between centers, mediated by the conduction electrons, causes the localized quasiparticle energies to spread and lower by an amount proportional to the square root of n sub 0 (n sub 0 being the density of centers). The proportionality factor is greater, by a factor of the square root of 2, in the ferromagnetic state than in the paramagnetic state. Near these localized quasiparticle energies are gaps in the conduction-band quasiparticle spectrum, the gaps being proportional to the cube root of n sub 0. With the exception of the immediate vicinity of these gaps, the conduction-band quasiparticle spectrum is spread and shifted by an amount proportional to n sub 0. These results are obtained by an equation-of-motion method that includes hole-electron pairing of a certain type. The latter allows one the flexibility of leaving unspecified the spin orientation of the electron occupying any given single-particle orbital. Author (TAB)

N70-20520# General Electric Co., Philadelphia, Pa.
SPACE PROCESSING OF ELECTRONIC CRYSTALS
E. C. Henry and L. R. Mc Creight *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 59-78 refs (See N70-20517 08-30)
Avail: CFSTI

A method for growing various high temperature oxidic crystals is described. The crystals are precipitated and grown from a glass solvent in which the desired crystal constituents have been previously dissolved. Typically, the desired crystals have a density of 5-8 grams/cc, and they settle out rapidly, due to gravity, in the much less dense molten glass matrix. It is proposed to conduct a space experiment on this process of growing crystals as a means of overcoming the gravitational effects, and equally importantly, at the same time conducting the experiment in a manner to obtain crystals with fewer vacancies and dislocations as a consequence of the near absence of convection that zero-g should provide.
Author

N70-20523# Tyco Labs., Inc., Waltham, Mass.
DIRECTIONAL SOLIDIFICATION OF MULTICOMPONENT SUPERCONDUCTING SYSTEMS UNDER ZERO g CONDITIONS
J. T. A. Pollock and Fritz Wald *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 135 145 refs (See N70-20517 08-30)
Avail: CFSTI

Metallurgical microstructure plays a major role, through its influence on magnetic flux pinning, on the critical current density of superconducting materials. It has been found in technological practice that the capabilities of superconducting materials, as measured in short length samples, are rarely realized when long lengths of the same material are wound in a solenoid. This degradation has been attributed to magnetically induced thermal instabilities. A method is proposed for the preparation of stable superconducting cables comprising a filamentary phase of one superconducting in a matrix of another. This is to be achieved by directional solidification of appropriate superconducting systems under 0 g conditions. Author

N70-20533# Westinghouse Electric Corp., Pittsburgh, Pa.
ZERO GRAVITY CRYSTAL GROWTH
Robert Mazelsky *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 297-305 refs (See N70-20517 08-30)
Avail: CFSTI

This talk briefly reviews the principles of crystal growth and describes the different techniques that are regularly used. The advantages and problems of the various techniques are characterized. It is shown that for at least the preliminary attempts at crystal growth, solution growth has the advantage over other techniques in that it will require the minimum amount of operator time, lower temperature operation, and will not require unusual safety requirements. An outline of the projected experiment in solution growth at zero gravity is described. Author

N70-20534*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TECHNIQUES FOR CHARACTERIZATION AND EVALUATION OF ZERO GRAVITY GROWN GALLIUM ARSENIDE
Arun P. Kulshreshtha, T. Mookherji, and G. M. Arnett *In its* Space Process. and Manufacturing 5 Feb. 1970 refs (See N70-20517 08-30)
Avail: CFSTI

Recent proposals concerning the advantages of purifying gallium arsenide and growing its single crystals in zero-gravity environment have led to an investigation into the possibilities of characterizing this material. The present paper discusses briefly several modern techniques which could be utilized to determine the ultratrace impurities and the dislocation-type imperfections and impurities influencing the electronic properties of gallium arsenide.
Author

N70-20540# North American Rockwell Corp., Thousand Oaks, Calif.
CRYSTAL GROWTH FROM MELTS IN ZERO g ENVIRONMENT
L. D. Fullmer and R. M. Housley *In* NASA. Marshall Space Flight Center 5 Feb. 1970 p 383-389 (See N70-20517 08-30)
Avail: CFSTI

The value of highly perfect single crystals to technology is discussed. Many potentially useful crystals which cannot be grown on earth because the melt cannot be contained could be grown from containerless melts in 0-g. Very desirable increases in perfection of other crystals currently being used could probably be achieved in zero g. The factors limiting perfection and their relation to gravity are discussed. Different techniques of growth in 0-g are discussed and a very versatile crystal pulling apparatus which combines the advantages of float zone refining and Czochralski growth is schematically described. Author

N70-20541# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES OF ZERO-GRAVITY EFFECTS ON SOLIDIFICATION
T. C. Bannister *In its* Space Process. and Manufacturing 5 Feb. 1970 p 390-402 refs (See N70-20517 08-30)
Avail: CFSTI

The major activities recently initiated within the space sciences laboratory in support of the manufacturing in space effort at the

Marshall Space Flight Center will be discussed. These efforts are primarily aimed toward scientifically defining the role of gravity in the various processes involving solidification. A motion picture of the solid/liquid interface of several transparent freezing materials will be shown. Author

N70-20542# Alabama Univ., Huntsville.
SINGLE CRYSTAL GROWTH FROM MELT UNDER SPACE ENVIRONMENT
Upendra Roy *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 403-421 refs (See N70-20517 08-30)
Avail: CFSTI

A brief outline of the methods of single crystal growth from melt under 1-g is presented and their relative merits discussed. The role of near 0-g environment and other practical parameters important to the growth of perfect single crystals is considered. The effect of interface shape, high-g, gamma-ray irradiation and electromagnetic body force is reviewed. The experiment to study the growth kinetics under various equivalent gravity fields is discussed in more general terms and a partial list of the candidate materials suitable for space crystal growth is presented. Author

N70-20543# Alabama Univ., Huntsville.
AN ANALYTICAL EXPERIMENTAL STUDY OF POSSIBLE EFFECTS OF GRAVITY ON CRYSTAL WHISKERS
Jack H. Davis *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 422-433 refs (See N70-20517 08-30)
Avail: CFSTI

This paper reports on the progress of analytical and experimental efforts to determine if a 1-g environment has any effect on whisker growth. It is found analytically that the best quality whiskers are the ones most likely to be destroyed by gravity. A centrifuge experiment is set up to check this idea experimentally. The centrifuge is also being used to measure directly the effect of increased gravity on crystal growth by vapor deposition where convection is important. Author

N70-20544# Lockheed Missiles and Space Co., Huntsville, Ala.
GRAVITY-DRIVEN AND SURFACE TENSION-DRIVEN CONVECTION IN SINGLE CRYSTAL GROWTH
Philomena G. Grodzka *In* NASA. Marshall Space Flight Center Space Process. and Manufacturing 5 Feb. 1970 p 434-447 refs (See N70-20517 08-30)
Avail: CFSTI

Analytical and mathematical studies of the floating-zone and the Czochralski techniques of growing single crystals are being conducted. The objective of these studies is to elucidate the role of convection in single crystal growth. Gravity-driven and surface tension-driven convection and possible couplings between these two convective modes will eventually be incorporated into the analyses. The analyses are expected to provide a basis for predicting the effects of a zero-gravity environment on crystal growth. Author

N70-20617# Naval Research Lab., Washington, D.C.
PROCEEDINGS OF SECOND SYMPOSIUM, 1969 SPRING SUPERCONDUCTING SYMPOSIA
25 Apr. 1969 66 p refs Conf. held at Washington, D.C., 1969
(AD-696938; NRL-6972) Avail: CFSTI CSCL 20/3

Contents: Superconductivity in degenerate semiconductors; Low carrier density superconductors; Superconductivity in low carrier density rock salt compounds; and Superconductivity in Free Electron Like superconductors. TAB

N70-20650*# Utah Univ., Salt Lake City. Dept. of Physics.
RADIATION KINETICS IN ELECTRONIC MATERIALS Semiannual Report
Abraham Sosin 15 Dec. 1969 7 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952384)
(NASA-CR-108995) Avail: CFSTI CSCL 20L

The formulation, structuring, and solution of models for degradation, recovery, and redegradation of minority carriers in solar cells are studied. The spontaneous and full recovery of lithium in irradiated solar cells is discussed. In developing computer based reaction kinetics for the diffusional aspects in solar cell damage and recovery, the main parameters are considered to be the concentrations of lithium, oxygen, vacancies, and other radiation produced electrical centers, and the electronic state of each of these reactants is treated separately: Li vs Li(+), V vs vs V(-), plus the inclusion of hole and electron concentrations. F.O.B.

N70-20669# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ANOMALOUS THERMAL CONDUCTIVITY OF FERROELECTRIC ROCHELLE SALT
Dj. Krstic and R. Blinc Oct. 1969 5 p refs Submitted for publication
(IJS-R-569) Avail: CFSTI

The thermal conductivity K sub C of a Rochelle salt single crystal was measured in the temperature range from -110 C to +33 C, and significant anomalies were found at both Curie temperatures. At the lower Curie point there is a dip, whereas at the upper Curie point there is a peak in K sub C. Author

N70-20700# Northwestern Univ., Evanston, Ill. Materials Science Dept.
NEUTRON DIFFRACTION STUDIES OF MATERIAL SUBJECTED TO HIGH PRESSURE Annual Report
L. H. Schwartz Jun. 1969 23 p refs
(Grant NSF GK-1730)
(AR-2) Avail: Issuing Activity

Using a double axis spectrometer, the magnetic moment of the hexagonal phase of MnAs was measured at several temperatures below 43 deg C. The results of a least squares analysis of the data show a magnetic moment consistently higher than that previously measured from magnetization data, suggesting incomplete saturation in the magnetization experiments. The compressibility of MnAs was measured in the range from 1 bar to 7 kbar using the lattice constants determined by high resolution neutron diffraction on a time-of-flight spectrometer. The distortions of a field cooled single crystal of iodide process chromium were determined by measuring the differences between the length changes of the Q direction and the other <100> directions, both at the Neel temperature and at the spin-flip temperature. The chemical structure of alpha manganese was studied by using small single crystals. X-ray measurements on powders of alpha manganese show no change in the given atomic positions. R.B.

N70-20754# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
RELATIVE EFFECTS IN LEAD TELLURIDE
James B. Conklin, Jr. (Ph.D. Thesis) 1 Jun. 1964 143 p refs
(Contracts DA-31-124-ARO(D)-92; Nonr-1841(51))
(AD-697836; TR-1; TR-8) Avail: CFSTI CSCL 20/12

The Augmented Plane Wave Method for calculating the band structure of a solid has been extended to include the relativistic terms of the two-component Hamiltonian which is obtained by two successive applications of the Foldy-Wouthuysen transformation to the Dirac Hamiltonian. The order of the secular equation is reduced by using basis functions which are basis partners for the irreducible representations of the double group. These functions are constructed from the solutions of the non-relativistic Hamiltonian for lead telluride. The forms of the relativistic matrix elements between them are found, with full use of group-theoretical techniques to simplify the calculation. These matrix elements are evaluated numerically, and the resulting Hamiltonian matrix is diagonalized to give the energy levels of lead telluride. The resulting

band structure appears to be reconcilable with the available experimental information about lead telluride and, it is hoped, will be of value in correctly interpreting the experimental data for the material. Author (TAB)

N70-20776# Stanford Univ., Calif. Dept. of Physics.
OPTICAL AND ELECTRON SPIN RESONANCE STUDIES OF FOURTH NEAREST NEIGHBOR CHROMIUM ION PAIRS IN RUBY
M. J. Berggren, G. F. Imbusch (Bell Telephone Labs., Murray Hill, N.J.), and P. L. Scott (Calif. Univ., Santa Cruz) Nov. 1969 31 p refs
(Contracts N00014-68-A-0381-0002; ARPA SD-87)
(AD-697982; TR-1) Avail: CFSTI CSCL 20/12

The bibliography consists of two sections. Section I pertains to resistors as discrete, miniature and microelements. Passive resistive elements are deposited on wafers, ribbon, and resistive sheet. The miniature and microelements are assembled into micromodules. Section II pertains to resistive elements which are deposited as integrated and microcircuit wafers. These integrated and microcircuits are constructed as a block or multilayer on a semiconductor substrate and combine to form hybrid microcircuits, integrated circuits, and thin-film circuits. Author (TAB)

N70-20825# Research Triangle Inst., Durham, N.C.
A STUDY OF THE DEPLETION REGION CARRIER GENERATION RATE DUE TO GOLD IMPURITIES IN SILICON UNDER ANISOTROPIC STRESS Interim Report, 1 Aug. 1968-1 Aug. 1969
J. L. Prince and J. J. Wortman Nov. 1969 107 p refs
(Contract F44620-67-C-0048)
(AD-697830; AFOSR-69-2815TR; IR-2) Avail: CFSTI CSCL 20/12

The thermal generation rate of charge carriers in a depletion region in gold-doped silicon was measured as a function of strain applied in the (100) direction over a range of temperatures. Thermal generation rate was also measured as a function of (100) strain at a single temperature. The technique used is relatively new and is based on the relaxation to equilibrium of a deeply depleted Metal-Oxide-Semiconductor capacitor. The generation rate was observed to increase nearly 100 percent from zero applied strain to an applied strain of 0.005, at 20 degrees C. Experimental results were explained using a model based on Shockley-Read statistics and results from deformation-potential theory. A good fit of theory to experimental results was obtained under the condition that the center of gravity of the two levels shifts upward with the hydrostatic coefficient of Nathan and Paul (1962). The electron capture coefficients characterizing the gold acceptor level were found to decrease with strain. Author (TAB)

N70-20934# Catholic Univ. of America, Washington, D.C. Vitreous State Lab.
RAMAN SCATTERING: PHONON DENSITY OF STATES IN GLASSES
R. Shuker, R. W. Gammon, P. Macedo, and T. A. Litovitz Dec. 1969 13 p refs
(Contract N00014-68-A-0506-0002)
(AD-697667; TR-5) Avail: CFSTI CSCL 7/4

When spatial disorder is present in solids the selection rules for first order Raman scattering breakdown and all vibrational modes are active. Thus, Raman spectra can reveal the phonon density of states in a disordered solid. Raman scattering data are reported for fused silica glass which confirm this. The data are in good agreement with Deans theoretical calculation of the density of vibrational states. Author (TAB)

N70-21022# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
NARROW BAND CONDUCTION IN A QUASI-AMORPHOUS LATTICE
P. Gosar Oct. 1969 5 p refs Presented at Intern. Conf. on Amorphous and Liquid Semiconductors, Cambridge, 24-27 Sep. 1969 Submitted for publication
(IJS-R-568) Avail: CFSTI

Narrow band conduction is considered in a solid formed by molecules i at quasi-random positions r sub i = R sub i + u sub i, where R sub i is a lattice vector of a certain periodic structure and u sub i a small random position vector. The structure of the current density operator is investigated. It is shown that one part of the current is induced by the random fluctuations of the electron transfer integrals. This current can be partially accounted for by the proper corrections of the electron velocities used in standard band theory calculations. The corrections are calculated for a three-dimensional parabolic and a one-dimensional sinusoidal energy band. Author

N70-21095 Catholic Univ. of America, Washington, D.C.
APPLICATION OF THE GREEN'S FUNCTION METHOD TO NONLINEAR EFFECTS AT THE FUNDAMENTAL FREQUENCY IN ANTIFERROMAGNETIC RESONANCE ABSORPTION
Ernest Louis Madsen (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-8899

Two-time Green's functions are employed work, and the linear response is obtained. Also, (n + 1)-time Green's functions (n > 1) are applied to obtain the first deviation from the linear. The latter problem is formulated and carried out up to the calculation of two remaining three-time Green's functions. Each of these is expanded in terms of a sum over all wave number eigenstates. Integral equations arise relating various functions involved. It is left to introduce relaxation effects and solve these equations. The procedure for performing this final calculation is outlined. The method of Green's functions is a steady state theory and is nonrestricted to the Weiss approximation. All quantities are calculable, given a reasonably correct Hamiltonian. Hence, no phenomenological quantities need be introduced as they are in Heeger's theory. Also, this theory is readily extended in its entirety whereas Heeger's theory gives only a value of the microwave field amplitude. Dissert. Abstr.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-20003# Naval Research Lab., Washington, D.C.
EFFECT OF A STATIC DISSIPATOR ADDITIVE ON THE CHARGING TENDENCY OF JET FUELS
Joseph T. Leonard and Homer W.Carhart 12 Nov. 1969 24 p refs
(AD-698119; NRL-6952) Avail: CFSTI CSCL 21/4

The effect of a static dissipator additive on the charging tendency of both JP-4 and JP-5 type jet fuels was examined at various flow velocities on a laboratory scale. For the documents use, the term charging tendency refers to the current generated by a given quantity of fuel when passing through a filter or an insulated section of piping rather than to the ability of a fuel to produce dangerously high potentials when loaded into a tank. It was found that when the conductivity of the fuel is increased by the addition of the static dissipator additive, the charging tendency also increases, passes through a maximum, and then decreases. Also, at higher flow velocities, there is an overall increase in the charging tendency of the fuel, and the position of the maximum in the charging tendency vs conductivity curve shifts to a higher conductivity range. Author (TAB)

N70-20187 Massachusetts Univ., Amherst.
A STUDY OF THE BURNING CONSTANTS OF HYDROCARBON FUEL DROPLETS
Richard Henry Sioui (Ph.D. Thesis) 1968 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-4185

A method of predicting the burning constants of suspended hydrocarbon drops based on a modified theoretical equation is presented. To develop this method, burning constants are calculated from a theoretical equation in eight different ways based on the combinations of two assumed flame temperatures and four average thermal conductivities. Experimental results are obtained which show that the burning constant of droplets in a mono-dispersed, liquid hydrocarbon fuel mist vary with both average initial drop size and fuel concentration. The effect of initial diameter on the combustion life-time of a droplet and the cyclic variation of flame velocity and flame volume with time observed in all of the experimental runs are also discussed. Dissert. Abstr.

N70-20421 Utah Univ., Salt Lake City.
STUDIES OF AMMONIUM PERCHLORATE BASED PROPELLANT IGNITION BY LOW CONVECTIVE HEAT FLUXES
Charles Peter Richardson (Ph.D. Thesis) 1968 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-1778

The ignition response to convective heating of a series of ammonium perchlorate-based composite propellants was determined. Ignition times were determined by use of photoconductive detectors which indicated the appearance of first flame in the dark convective heating environment. The light signal was shown to correspond in time to the rapid rise of surface temperature measured by means of infrared radiation from the surface. The ignition times could be correlated as a function of the mean surface heat flux; and, except for their measured effect on the heat transfer rates, no effect of gas velocity, pressure, or gas composition on the ignition times was noted. Changes in surface texture resulting from the use of various sizes of oxidizer particles showed no significant effect on ignition times for the range of heating times employed in these tests. In all cases, it was possible to represent the ignition data in terms of a thermal ignition model which considers a single, exothermic, Arrhenius type surface reaction. Dissert. Abstr.

N70-20731*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
OSCILLATORY COMBUSTION IN ROCKETS Semiannual Report, 1 Jun. 1969-31 Nov. 1969
D. Juedes, C. W. Savery, and R. Sowls Nov. 1969 25 p refs
(Grant NGR-50-002-017)
(NASA-CR-108992; SAR-11) Avail: CFSTI CSCL 21I

A summary of progress during the reporting period on the investigation of droplet vaporization in the region of the critical point is presented. The investigation consists of two types of experiments. In the first, droplets are suspended on a thermocouple bead and exposed to a flowing stream of heated air at elevated pressures. In the second, droplets are caused to fall through a stagnant high temperature, high pressure gas environment. Modifications to the apparatus for obtaining photographic histories of CO2 evaporating in helium are described. Gas phase pressures from 600 to 1500 psig, and temperatures ranging from 60 to 1500 F were used. Results are summarized in charts. F.O.S.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-19807# Boeing Co., Renton, Wash. Commercial Airplane Div.
USE OF CHANGES IN BLADE PASSAGE FREQUENCY TO REDUCE DISCRETE TONE FAN NOISE
Matthew I. Abbona 26 Apr. 1969 51 p refs (D6-22587)
Avail: CFSTI

The use, for fan or compressor first-stage rotor, of fundamental blade passage frequencies which are higher or lower than those in common use in present airplane engines has been investigated theoretically, in order to determine the reduction of fan or compressor noise it can produce. The application of this technique of noise reduction to engine design has been explored, and the modifications to engine and airplane design that are necessary for its implementation, are indicated. Likewise, similar modifications which could simplify such implementation or make the technique more rewarding as for noise reduction, are presented. Experiments which are required for determining the validity of the theoretical results and, at the same time, are useful in shedding additional light on the question are suggested. Author

N70-19835*# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
DEVELOPMENT OF LOW COST ABLATIVE NOZZLES FOR SOLID PROPELLANT ROCKET MOTORS, VOLUME 1 Final Report
J. R. Mathis and R. C. Laramee 12 Feb. 1970 133 p
(Contract NAS3-10288)
(NASA-CR-72641-Vol-1) Avail: CFSTI CSCL 21H

The low cost materials and processes applicable to full sized nozzles for 260 in. solid rockets are investigated. Over 20 materials were subjected to increasingly severe tests, consisting of mechanical, physical, and thermal properties and evaluation in nozzles of three different sizes, ranging in throat diameter from 0.34 to 8.1 inches. Resulting data were analyzed, and the better performing materials were employed in the design and performance prediction of four full sized nozzles for 260 in. solid rockets. Conclusions are that acceptable full sized nozzles can be fabricated at substantially lower cost than those produced in the past. Author

N70-19836*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
NEUTRAL DENSITY MEASUREMENTS IN AN NH3 MPD ARC Final Report, 22 Jul. 1968-31 Dec. 1969
Per Gloersen 31 Dec. 1969 27 p refs
(Contract NAS1-8461)
(NASA-CR-66889) Avail: CFSTI CSCL 21B

The experimental determination of the range of applicability of a vacuum ultraviolet absorption spectrometry technique to detecting neutral atom and molecule constituents in the exhaust stream of missile profile density (MPD) arc jet is studied with emphasis on measuring the atom densities in an ammonia-fueled MPD arc jet exhaust. An analysis for the reduction of transmissivity data in terms of nitrogen atom flow rates is presented, and it is concluded that the low percentage of nitrogen and hydrogen atoms in the exhaust plum indicate that these are of little importance in determining the performance of the arc. F.O.S.

N70-19843*# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
DEVELOPMENT OF LOW COST ABLATIVE NOZZLES FOR SOLID PROPELLANT ROCKET MOTORS, VOLUME 2 Final Report
J. R. Mathis and R. C. Laramee 12 Feb. 1970 397 p
(Contract NAS3-10288)
(NASA-CR-72641-Vol-2) Avail: CFSTI CSCL

The object of this program was to investigate and evaluate low cost materials and processes applicable to full sized nozzles for 260 in. solid rockets. Over 20 materials were subjected to increasingly severe tests, consisting of mechanical, physical, and

thermal properties and evaluation in nozzles of three different sizes, ranging in throat diameter from 0.34 to 8.1 inches. Resulting data were analyzed, and the better performing materials were employed in the design and performance prediction of four full sized nozzles for 260 in. solid rockets. Conclusions are that acceptable full sized nozzles can be fabricated at substantially lower cost than those produced in the past. Author

N70-19902 Advisory Group for Aerospace Research and Development, Paris (France).
SUPERSONIC TURBO-JET PROPULSION SYSTEMS AND COMPONENTS
J. Chauvin, ed. (von Karman Inst. for Fluid Dyn.) Slough, England Technivision Services Aug. 1969 480 p refs
(AGARDograph-120) Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

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N70-19903 Air Force Systems Command, Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
INTRODUCTION TO LECTURES ON SUPERSONIC TURBOMACHINERY
E. G. Johnson *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 5–24 refs (See N70-19902 08-28)
Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Significant innovations and performance trends for supersonic fluid machine components and systems, which predict a bright future for this class of energy conversion devices, are reviewed. A brief tribute is paid to those innovators whose works form the foundations of present day turbine engine technology. Author

N70-19904 Bristol Siddeley Engines, Ltd. (England). Advanced Propulsion Research Group.
SUPERSONIC INLETS
R. Hurd *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 25–58 refs (See N70-19902 08-28)
Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Penham, New York 10803 (Attn. Mr. A. L. Candido)

The supersonic inlet is a vital and integral part of any air breathing propulsion system. Its basic role and nature are reviewed together with the various forms it can take, its modes of operation and the main parameters used to express supersonic inlet performance. The inlet is considered as an isolated component for the purpose of indicating the problems that are fundamental to the inlet itself, i.e. the inviscid aspects, influence of viscosity, boundary layer control, off-design performance, estimation of performance etc. Some comments on the question of achieving the required inlet/engine match by means of variable geometry and on the installation and integration of the real inlet with the engine and airframe are given. Author

N70-19905 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.
SUPERSONIC COMPRESSORS
J. Chauvin, F. Breugelmans, and A. Janigro *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 59–178 refs (See N70-19902 08-28)
Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The advantages of using supersonic compressors for propulsion systems of airborne vehicles are stressed. A brief historical summary, presenting the types of supersonic compressor, and those effectively tested are given. Results obtained by early workers are discussed. The recent progress in axial flow supersonic compressors is reviewed, on the basis of cascade, rotor, and stage results. The concept of unique incidence, pseudo-shock systems, and back pressure effects is brought forward, together with a possible loss correlation. The problem of high turning blading for stators is examined. Three dimensional design methods are discussed for low and high hub-tip ratios. A review on supersonic radial machines is made. The perspective for both radial and axial machines is sketched, and the short and medium range requirements for research and development are briefly discussed. Author

N70-19906 New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
SUPERSONIC COMBUSTION TECHNOLOGY
A. Ferri *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 179–240 refs (See N70-19902 08-28)
Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The performances of a supersonic burning ramjet (scramjet) are discussed. It is shown that scramjets are preferable to ordinary ramjets at hypersonic speeds. Problems related to vehicle engine integration are discussed. The importance of such integration is emphasized. Parameters related to cycle selection are reviewed. The advantages of combustion with average constant pressure are described; possible performances of fixed geometry accelerating engines are presented. Sensitivity of such performances to deterioration of engine components is investigated. It is shown that the sensitivity is small. Problems related to practical development of scramjets are reviewed, and the difficulty of testing at Mach numbers above 10–12 is indicated. Scientific problems related to the mechanism of combustion at supersonic speed are discussed, as well as maintaining efficient supersonic combustion. Supersonic combustion controlled by mixing is selected. Two mechanisms of combustion are described: one is supersonic combustion controlled by the conversion process, and the second is controlled by diffusion. Author

N70-19907 Rolls-Royce, Ltd., Derby (England). Aero Engine Div.

AIR COOLING OF TURBINE BLADES AND VANES

G. A. Halls *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 241–285 refs (See N70-19902 08-28)

Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The advantages of operating aircraft turbines at high turbine entry temperatures are briefly reviewed, in order to establish the case for air cooling of the hot turbine components. How turbine entry temperatures have increased as a result of air cooling is reviewed historically. The manufacturing, metallurgical, and heat transfer problems of cooling vanes and blades are discussed and mention made of the contributions that can be made by attention to turbine aerodynamic design. The factors that lead to good blade cooling are identified using a simple approach. How well practical designs have met these requirements are discussed. The limitations of the simplified approach are enumerated and a correlation is proposed which overcomes many of them. Most practical cooled vanes and blades operate with a nonuniform chordwise temperature The reasons for this and its effects on the lives of the components are discussed. Methods of controlling the chordwise temperature distribution by attention to design or by using sophisticated cooling configurations such as impingement, film, and transpiration cooling are discussed, both from the theoretical and the practical standpoint. Author

N70-19908 Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

EXHAUST NOZZLES

P. Carriere *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 287–378 refs (See N70-19902 08-28)

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The behaviour of a de Laval nozzle in vacuo is first examined and its intrinsic properties are pointed out. The parameters controlling the flow rate are analyzed, and practical methods for adjusting the results of the one-dimensional theory are established. Viscosity and the real gas effects are also discussed. The present methods of computing the thermal effects on the walls are presented and discussed. The adaptation of a nozzle to given atmospheric flight conditions is analyzed; the present knowledge on turbulent separation and reattachment of jets is recalled, as well as its means of practical application. Several examples of nonclassical nozzles are discussed by comparison with the de Laval nozzles (central body nozzles, dual flux nozzles, blow in door system, and nonsymmetrical nozzles for hypersonic flight). Author

N70-19910 Advisory Group for Aerospace Research and Development, Paris (France).

DISCUSSION ON FUTURE PROBLEMS OF SUPERSONIC FLUID MACHINERY

C. Casci, A. Ferri, P. Carriere, J. Chauvin, G. A. Halls et al *In its* Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 441–445 (See N70-19902 08-28)

Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Future problems in supersonic fluid machinery including combustion chambers, air intakes, and exhaust nozzles are discussed, along with supersonic compressors, turbine blades, and three dimensional boundary layer problems. J.A.M.

N70-19911 IIT Research Inst., Chicago, Ill. Dept. of Mechanical and Aerospace Engineering.

INTERFACE PROBLEMS OF HIGH SPEED AIR-BREATHING AIRPLANE ENGINES

A. A. Fejer *In* AGARD Supersonic Turbo-Jet Propulsion Systems and Components Aug. 1969 p 447–470 refs (See N70-19902 08-28)

Copyright. Avail: Technvision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Air breathing engines intended for the propulsion of a long range supersonic transport plane at speeds up to M = 4 are being considered. The relationship between airplane mission profile and engine configuration is indicated, and the demands placed on the individual engine components are surveyed. A procedure is outlined for the matching of these components to yield efficient operating conditions over the required performance range. Problems due to transient phenomena at the interfaces between engine components are also indicated. Author

N70-19927*# Colorado State Univ., Fort Collins.

EXPERIMENTAL INVESTIGATIONS INTO THE PERFORMANCE OF A 20 cm HOLLOW CATHODE THRUSTER

Giuseppe Palumbo, Paul Wilbur, and Richard Vahrenkamp *In its* Biol. and Eng. of Space and Planetary Life Systems Sep. 1969 20 p refs (See N70-19925 08-34)

Avail: CFSTI CSCL 21C

The performance of a hollow cathode mercury thruster was evaluated for improved operation. An increase in arc voltage was produced by: (1) applying a magnetic field within the cathode pole piece region; (2) reducing hollow cathode propellant flow rate; and (3) varying effective baffle area to reduce discharge losses. It is shown that performance improved through increased electron energy and thus higher ionization cross sections; however, discharge losses appeared to increase again with lifetime. G.G.

N70-20439*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

RESEARCH AND DEVELOPMENT OF AN INERT FLUID INJECTION SYSTEM FOR A SOLID PROPELLANT ROCKET, PHASES 1 AND 2 Final Project Report, 20 Sep. 1968-20 Apr. 1969

20 Apr. 1969 134 p refs

(Contract NAS5-11614)

(NASA-CR-108899; HREC-1614-1; LMSC/HREC-D148939) Avail: CFSTI CSCL 21H

Evaluation of the concept of trimming the velocity of an orbital vehicle by producing a usable level of propulsive work injects an inert (nonreactive) fluid into a spent solid rocket motor case. Residual heat stored in the rocket motor case is utilized to vaporize and superheat the inert fluid before it is expanded to ambient vacuum conditions by means of the rocket motor nozzle. Utilizing this system, incremental changes in the velocity of an orbital vehicle can be accomplished without the need for auxiliary propulsion units. The mechanism for transfer of heat from the motor chamber walls to the injected fluid was established. The information was utilized in the construction of detailed analytical thermal models of the TE-364-3 rocket motor (Delta third-stage propulsion unit) and of two experimental, subscale test motors developed. A parametric performance study was conducted using a digital computer program developed for this purpose. Two experimental model configurations, spherical and cylindrical, were designed and constructed to simulate spent solid rocket motors. Author

N70-20484*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

X B-70 COMPRESSOR-NOISE REDUCTION AND PROPULSION-SYSTEM PERFORMANCE FOR CHOKED INLET FLOW

Terrill W. Putnam Ronald H. Smith Washington Mar. 1970 26 p refs

(NASA-TN-D-5692; H-578) Avail: CFSTI CSCL 21E

An investigation was conducted with the XB-70 attached to a thrust stand to observe compressor-radiated noise and propulsion-system performance as the inlet throat area was reduced to form an aerodynamically choked flow. The anticipated compressor-noise reduction was not experienced. Tests at constant engine speed settings disclosed only minor noise reductions as a result of choking the inlet. Additional tests were performed with the inlet fixed full open and the engines set at successively higher speeds from 60-percent to 87-percent rpm. These tests disclosed considerable noise reduction (10 decibels) in the compressor-blade passing frequencies at engine settings above 80-percent rpm. Thus, it was concluded that most of the noise reduction expected for the throat-closing tests, which were done at engine settings of 87-percent rpm and higher, had already occurred and that only slight additional suppression could be expected when the throat area was decreased to choke the flow. Choking the flow resulted in thrust losses due to decreased total-pressure recovery and airflow in the inlet. These test results suggest that major noise reduction may be obtained without a full-choked flow and the concurrent propulsion system performance loss. Author

N70-20566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY TESTS OF A SIMPLIFIED MODULAR TURBOJET COMBUSTOR

Richard W. Niedzwiecki Washington Mar. 1970 39 p refs

(NASA-TN-D-5688; E-5220) Avail: CFSTI CSCL 21E

Performance of a rectangular sector of a turbojet combustor consisting of an array of 48 modules was determined. Each module incorporated a carburetor which mixed ASTM-A1 fuel with air, a swirler, and a flat plate surrounding the swirler, which stabilized combustion. Performance was evaluated at inlet air temperatures of 800 and 1050 F (589 and 839 K), a pressure of 3 atmospheres, and reference velocities up to 150 feet per second (45.7 m/sec). The best combustor produced a total pressure loss of 6.4 percent at a diffuser inlet Mach number of 0.25 and a combustor exit-to-inlet temperature ratio of 2.5. Combustor exit temperature distribution improved with increasing-inlet air temperature. Pattern factors of 0.25 to 0.29, which were obtained with 600 F (589 K) inlet air, were reduced to 0.15 to 0.19 when inlet-air temperature was increased to 1050 F (839 K). All combustor configurations produced combustion efficiencies near 100 percent for fuel-air ratios greater than 0.015. Author

N70-20572*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CYCLE EFFICIENCY OF AIR-COOLED STEAM POWERPLANTS

Richard J. Weber Washington Mar. 1970 18 p

(NASA-TM-X-1970; E-5420) Avail: CFSTI CSCL 10B

Steam powerplants for mobile applications such as automobiles must use air-cooled condensers to reject waste heat. A preliminary study is made of the effect of major design parameters on the efficiency of various steam cycles of this type. The efficiency of a typical system of the type usually considered for steam cars can be improved by a factor of 1.3 through use of a more complex system that employs an air turbine. Author

N70-20645*# Martin Marietta Corp., Denver, Colo.

ADVANCED PROPELLANT MANAGEMENT SYSTEM FOR SPACECRAFT PROPULSION SYSTEMS Summary Report

Daniel L. Balzer Sep. 1969 27 p

(Contract NAS9-8939)

(NASA-CR-102181; MCR-69-437) Avail: CFSTI CSCL 21H

Propellant management techniques were surveyed and divided into six categories for evaluation: nonmetallic bladders and diaphragms, metallic bladders and diaphragms, capillary forces, sliding seal piston, metallic bellows, and miscellaneous systems. To minimize the possibility of obtaining a biased evaluation, each grouping was studied independently. A detailed design and analysis of the selected propellant management concept was conducted based on existing criteria. The major areas considered significant to successful operation of the expulsion device were: (1) hydrostatic stability to axial and lateral accelerations; (2) hydrodynamic stability to axial and lateral accelerations; (3) effect of propellant resettle characteristics on liquid collection time; (4) expulsion efficiency; (5) outflow characteristics; (6) compartment refill capability; and (7) retrofit design, propellant siphoning during adverse acceleration environments. Limitations, research implications, and recommendations are also noted. J.A.M.

N70-20676*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

OPTICAL MEASUREMENT OF MULTIPLUME INTERACTION Interim Report

C. E. Craven Aug. 1969 168 p

(Contract NAS8-21285)

(NASA-CR-102507; LMSC/HREC D148854; TM-54/20-236) Avail: CFSTI CSCL 21H

This report documents base and exhaust flowfield data that were collected throughout a scaled model test series, performed to investigate two configurations of multinozzle rocket engines operating at high altitudes. The tests were designed to provide data to facilitate a general analysis of complex flow fields about multinozzle rocket base configurations. The four-nozzle model and the five-nozzle model experiments are discussed. The four-nozzle discussion presents the test results according to the measuring devices used; i.e., pressure; hot wire and laser velocimeter. The five-nozzle data are also presented according to the measurement used in the test, i.e., flow visualization, pressure and hot wire. In the flow visualization and oil flow technique is discussed that provides an indication of the nozzle exhaust and base flow activity. Author

N70-20687*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOUND MEASUREMENTS ON A 4000-POUND-THRUST HIGH-BYPASS-RATIO TURBOFAN ENGINE

Loren W. Acker, Joseph R. Balombin, and James W. Coats Washington Mar. 1970 33 p refs

(NASA-TM-X-1950) Avail: CFSTI CSCL 21E

Sound measurements were made on a 4000 pound thrust, high bypass ratio turbofan engine. Sound data were obtained at various engine speeds as the fan and core engine nozzle areas were changed. The overall engine noise was dominated by a pronounced discrete tone corresponding to the fan blade passage frequency. The calculated perceived noise levels were about 15 decibels higher than overall sound pressure levels. Author

N70-20772*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE APPLICATIONS TECHNOLOGY SATELLITE APOGEE ROCKET MOTOR: A SUMMARY REPORT

R. G. Anderson 1 Feb. 1970 59 p refs

(Contract NAS7-100)

(NASA-CR-109123; JPL-TM-33-338) Avail: CFSTI CSCL 21H

This report documents the design, development, qualification testing, and flights of a spacecraft-stage solid propellant rocket motor that was used to transfer the NASA Goddard Space Flight Center Applications Technology Satellite from its initial elliptical trajectory to a near-synchronous earth orbit. The motor fires at the apogee position of a highly elliptical transfer orbit to place the spacecraft in a circular orbit at synchronous altitude (22,300 miles). The mission requirements for precise motor thrust vector alignment during the burn phase and for dynamic balance before, during, and after burning are unique and stringent; therefore, the development phase has focused on producing precision components. Most developmental tests used chambers fabricated from AISI 410 stainless steel; however, a later program requirement for nonmagnetic

materials caused a change to chambers of 6A1-4V titanium alloy. Several development tests, all qualification units, and all flight motors have used the titanium chamber. The motor development phase consisted of a logical sequence of testing to confirm processing, component design, and survival ability in simulated booster and space environments, and to establish preliminary performance characteristics. The qualification phase, which consistec of testing eight units at simulated altitude while spinning at 100 rev/min with propellant grains conditioned to 40 or 100 F, established the exact performance characteristics of the motor. Author

N70-20850*# Techtran Corp., Glen Burnie, Md.
OPTIMUM DESIGN OF BY-PASS ENGINE WITH FLOW MIXING [DIE OPTIMALE AUSLEGUNG DES ZWEIKREISTRIEBWERKS MIT STRAHLMISCHUNG]
A. Hartman Washington NASA Feb. 1970 19 p refs Transl. into ENGLISH from Proceedings of Conf. on Wiss. Ges. fur Luft- und Raumfahrt, und Deut. Ges. fur Raketentech. und Raumfahrtforsch (Berlin), 14-18 Sep. 1964 11 p
(Contract NASw-1695)
(NASA-TT-F-12843) Avail: CFSTI CSCL 21E

Theoretical and experimental investigation of a bypass jet engine with flow mixing. Results obtained on a digital computer are presented for: the effect of pressure ratio in the primary flow, the effect of intake air temperature, the effect of bypass ratio, and the effect of nacelle drag. Thrust and efficiency of the bypass engine with mixing are discussed and compared with those of a bypass engine without mixing and of a conventional jet engine. The effects of partial mixing and limited mixing chamber cross section are also examined. It is shown that for large helicopters, a bypass with mixing provides higher thrust for rotor drive, a lower and more uniform temperature distribution in the exhaust gas, and a lower noise level. Its lower fuel consumption makes this type of engine more economical for both long and short haul operations. Author

N70-20852*# Techtran Corp., Glen Burnie, Md.
CONTRIBUTION TO THE DUAL-FLOW ENGINE WITH AFTERBURNER [BEITRAG ZUM ZWEIKREISTRIEBWERK MIT NACHVERBRENNUNG]
A. Meffert Washington NASA Feb. 1970 22 p refs Transl. into ENGLISH from Wiss. Ges. fur Luft- und Raumfahrt EV (WGLR) (German), v. 9, no. 12, 1962 p 360-370
(Contract NASw-1695)
(NASA-TT-F-12844) Avail: CFSTI CSCL 21E

In addition to the turbojet with afterburning, the ramjet, and the turboramjet, the bypass turbojet with afterburning is frequently suggested for propulsion of supersonic aircraft. This study will compare the bypass turbojet with afterburning with its competing power plants in order to determine the conditions under which the former may be superior. The initial results being discussed were obtained without regarding engine drag and weight. The influence of the controlling parameters of the bypass turbojet with afterburner (bypass ratio, bypass pressure ratio, fuel flow rate, and fuel distribution on both flows) on the performance data and the corresponding optimal relations are investigated. Optimal cycles of the by-pass turbojets with afterburning are determined and compared with those of ramjets and turbojets. Author

N70-20895*# Techtran Corp., Glen Burnie, Md.
STUDIES OF VAPORIZING COMBUSTERS FOR GAS TURBINES, REPORT NO. 1 [GASU TABINYO JOHATSUKEI NENSHOKI NO KENKYU, DAI 1 HO]
Shoichi Tsuji Washington NASA Feb. 1970 39 p refs Transl. into ENGLISH from Ishikawatima-Harima Giho (Japanese), v. 9, no. 3, May 1969 p 233-247
(Contract NASw-1695)
(NASA-TT-F-12861) Avail: CFSTI CSCL 21E

A theoretical and experimental study is presented of a film vaporizing combuster for gas turbines covering the vaporizing characteristics of liquid fuel film, flame spreading and stability, performance tests on a model combustor and certain practical design considerations. A general discussion of conventional systems and their deficiencies is provided. Basic theoretical and practical experimentation is reported on factors governing the spreading of a thin liquid fuel film over the vaporizer plate induced by a hot air flow over the plate. Factors considered are heat flux in the vaporizer plate, the temperature and velocity of the air flow, fuel feed rates and the temperature of the liquid fuel. Author

N70-20908# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATION OF AIRCRAFT AND ROCKET POWER PLANTS
A. A. Shevyakov 5 Feb. 1969 438 p Transl. into ENGLISH from Avtomatika Aviatsionnykh i Raketnykh Silovykh Ustanovok (Moscow), 1965 p 1-348
(Contract AF 33(657)-16409)
(AD-696298; FTD-HT-23-759-67) Avail: CFSTI CSCL 21/5

First published in 1960, this second edition, revised and enlarged, textbook is intended for aeronautical schools of higher education, and may also be useful to engineers and scientific workers. The book, based partly on the author's own work, deals with automatic regulation and control of aircraft and rocket power plants, discusses control systems used in turbojet, turboprop, ramjet, and liquid-rocket engines and nuclear and other power plants. Special attention is given to safety requirements. No personalities are mentioned. There are 38 references 28 Soviet (3 translations), 9 in English, and 1 German. Author (TAB)

N70-20945# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF INSTITUTIONS OF HIGHER LEARNING, POWER ENGINEERING, SELECTED ARTICLES, VOLUME 2, NO. 8, 1968
E. V. Golubovskii et al 5 Jun. 1969 15 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavendenii, (Minsk), v. 11, no. 8, 1968 p 66-70, 89-94
(AD-693393; FTD-HT-23-83-69) Avail: CFSTI CSCL 21/5

Contents: Numerical calculation of the temperature of locking joints; and Selection of characteristics of a high-temperature cooled gas turbine. TAB

N70-21000# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INCREASING THE EFFICIENCY OF TRANSPORT GAS TURBINE ENGINES BY USING CYCLICAL COMBUSTION
V. E. Mikhaltsev 19 May 1969 14 p refs Transl. into ENGLISH from Iav. Vyssh. Ucheb. Zaved. Mashinostro. (Moscow), no. 2, 1968 p 107-112
(AD-697618; FTD-MT-24-492-68) Avail: CFSTI CSCL 21/5

A method is proposed for increasing the efficiency of a gas turbine engine by introducing a cyclical combustion process. The engine consists of a common receiver containing 29 combustion chambers provided with automatic inlet valves. From each chamber the gas flows into the nozzle diaphragm channels. The double arrangement of the combustion chambers along the periphery was dictated by the necessity of reducing the inlet flow velocity by increasing the chamber cross-section area. The air flows through an annular slit between the chamber wall and special deflector, cools the flame tube, and after a 180-degree deflection, enters the cascade of automatic valves. In the cyclical combustion regime the fuel, which is supplied with a plunger-type pump, is atomized and ignited by the chamber wall and by the remaining combustion products. The pressure rise in the chamber closes the valves, which cut off the air flow from the receiver. The combustion stability and efficiency depend on the cycle frequency. The efficiency of cyclical combustion increases with the increase in the heat liberation rate and the reduction of the nozzle diaphragm area in a high pressure

turbine. The greatest efficiency may be achieved in low and medium power gas turbine engines. In gas turbine engines with output powers up to 5000 kw operating with cyclical combustion and a 300-500 kcal/sec heat liberation rate, the efficiency can be increased. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-19824# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

HIGH-ENERGY RAYS AND THE NEUTRINO SEA

M. P. Rekalo 1969 29 p refs In RUSSIAN Presented at the Third Conf. on Axiomatical Field Theory and Theory of Elementary Particles, Kiev

(ITF-69-44; Conf-690417-14) Avail: CFSTI

An influence of the neutrino sea, predicted in many models of the Universe, on the penetration of high energy cosmic rays: protons, electrons, and neutrino, was investigated. It is shown that a known maximal energy of cosmic rays allows establishment of the upper limit of a Fermi energy of the neutrino in the Universe that is three orders better than an earlier existing value. It is shown that high energy electron penetration through the Universe defines itself essentially by the Fermi energy of the neutrino sea. It is shown also that study of an energy spectrum of the cosmic rays allows a check of the validity of a big bang model of the Universe, and clears up the question of existence of anisotropic neutrino currents in the Universe. Author (NSA)

N70-19848*# Florida Univ., Gainesville. Dept. of Physics and Astronomy.

ATOMIC PHYSICS AND THE POLAR CAP

A. E. S. Green and D. J. Strickland [1969] 87 p refs

(Grant NGL-10-005-008)

(NASA-CR-108236) Avail: CFSTI CSCL 03B

Fundamental mechanisms in polar cap phenomena are discussed from the standpoint of atomic physics. Emphasis is placed on processes stimulated either by photons, electrons, or protons. A characterization of the special morphological features of polar cap phenomena distinct from auroral zone or other atmospheric phenomena is included. A state-of-the-art review is given on atomic physics and planetary aeronomy. D.L.G.

N70-19870*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.

IMP-D AND IMP-E: EXPLORER 33 AND EXPLORER 35 Final Report

J. A. Van Allen Jan. 1970 94 p refs

(Contract NAS5-9076)

(NASA-CR-108771) Avail: CFSTI CSCL 04A

A bibliography of publications as of January 1970 and a compilation of abstracts of each item in the bibliography is given for solar X-ray flares measured by the Explorer 33 and Explorer 35 satellites. A catalog of solar X-ray flares whose peak intensity exceeds that of the ambient quiet sun by a factor greater than four is included. R.B.

N70-20067*# National Aeronautics and Space Administration, Washington, D.C.

THE PHYSICS OF PARTICLES AND OF COSMIC RAYS

In its Rept. to COSPAR, French Space Program Feb. 1970 p 47-63 refs (See N70-20064 08-30)

Avail: CFSTI

The activities of the Electron Physics Department are discussed. Other topics covered include: preliminary results obtained with satellites IRIS and HEOS 1, preparation for three experiments with the European satellite TD, X-ray astronomy, rocket experiments, balloon experiments, high energy primary cosmic electrons, gamma and astronomy, gamma ray balloon experiments, and theoretical nuclear astrophysics. The activities of centers for studies of space radiation, corpuscular physics, and low radioactivity are also presented. Author

N70-20089# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

ENERGY SPECTRA AND TIME PROFILE OF PROTONS EMITTED DURING THE SOLAR FLARE OF 9 JUNE 1968

J. Engelmann, A. Hautdidier, and L. Koch [1969] 13 p refs Presented at the 11th Intern. Conf. on Cosmic Rays, Budapest, 25 Aug. - 4 Sep. 1969

(CEA-CONF-1404; CONF-690814-4) Avail: CFSTI

Energy spectra and flux variations with time of protons emitted during the solar flare of June 9, 1968 were studied with the proton spectrometer aboard the IRIS satellite. The detector is a dE/dx semiconductor telescope with a field of view of 0.3 sq cm sterad. The energy range covered by the instrument is 26 to 400 MeV. Energy and rigidity spectra obtained at various times after the event are presented. Furthermore, the time profile of six energy windows was drawn and its complex structure seems to be explainable by the magnetic characteristics of interplanetary space after the time of the solar flare. Author (NSA)

N70-20244# Observatorio del Ebro, Tortosa (Spain). Ionospheric Section.

INFLUENCE OF THE SOLAR ACTIVITY OF THE TOTAL ELECTRON CONTENT OF THE IONOSPHERE OVER TORTOSA 1964 - 1965 Scientific Report, 1 Mar. 1968 - 28 Feb. 1969

Eduardo Galdon and Luis F. Alberca 30 Mar. 1969 28 p refs

(Contract AF 61(052)-924)

(AD-695488; AFCRL-69-0422 ; SR-3) Avail: CFSTI CSCL 4/1

Data in previous papers dealing with the daily and seasonal variation of the total electron content over Tortosa, indicated the necessity of evaluating the effect of the solar cycle on the TEC in order to separate this effect from the seasonal variation. The present paper deals with this problem. Author (TAB)

N70-20363*# Harvard Coll. Observatory, Cambridge, Mass.

EXTREME ULTRAVIOLET OBSERVATIONS OF ACTIVE REGIONS IN THE CHROMOSPHERE AND THE CORONA

Robert W. Noyes, George L. Withbroe, and Robert P. Kirshner Oct. 1969 28 p refs

(Contract NASw-184)

(NASA-CR-108858; TR-14) Avail: CFSTI CSCL 03B

New observations of solar active regions were obtained by the EUV spectroheliometer aboard the OSO-4 spacecraft. From the observations the enhancement in active regions of the emission from ions formed at various temperatures in the chromosphere and corona was determined. The results are in accord with a simple model of active regions, for which the active region pressure is about five times the quiet sun pressure; the temperature gradient in the transition zone is about five times the quiet sun value; and the coronal temperature above active regions is slightly increased. Author

N70-20441*# California Inst. of Tech., Pasadena.

COSMIC RAY NEGATRON AND POSITRON SPECTRA OBSERVED NEAR FORT CHURCHILL IN 1968

K. P. Beuermann, C. J. Rice, E. C. Stone, and R. E. Vogt Aug. 1969 20 p refs

(Grant NGL-05-002-007)

(NASA-CR-108937; SRL-69-7) Avail: CFSTI CSCL 04A

The differential energy spectra of cosmic ray positrons and

negatrons between 12 and 210 MeV were measured with a balloon borne magnetic spectrometer launched from Fort Churchill, Canada, in summer 1968. Since the geomagnetic cutoff varies with time, separate spectra for the local day and night intervals are presented. In addition, the corrections for atmospheric secondary electrons are discussed in detail. The solar modulation of the positron flux is compared with the modulation of cosmic ray nuclei. Author

N70-20498# National Univ. of Ireland, Dublin. Dept. of Physics.
RADIO AND OPTICAL EMISSION FROM HIGH ENERGY COSMIC RAYS Final Scientific Report, 1 Jan. 1967-31 Aug. 1969
Neil A. Porter 17 Sep. 1969 110 p refs
(Grant AF-EOAR-27-67)
(AD-695838; AFOSR-69-2684-TR) Avail: CFSTI CSCL 3/2

A fast optical Cerenkov system has been used to search for gamma-rays from pulsars in the energy region 1000-10,000 Gev. Analysis has been carried out for both a continuous flux and a pulsed flux at the pulsar frequency. Several experiments have been carried out on radio pulses emitted by extensive air showers in the atmosphere. A long distance coincidence experiment, a correlation between radio pulses and particles, and between radio pulses and optical Cerenkov pulses have been carried out at 44 and 70 MHz. Pulses in the U.H.F. Band at 520-550 MHz have been observed in coincidence with particles. Author (TAB)

N70-20584*# Bellcomm, Inc., Washington, D.C.
ON THE GENERATION AND INTERACTION OF HIGH ENERGY MUONS
G. B. Khristiansen 24 Dec. 1969 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 37, no. 9, 1969 p 1482-1494
(Contract NASw-417)
(NASA-CR-108927) Avail: CFSTI CSCL 04A

Intensive studies of cosmic rays have been conducted which consisted of experiments on generation and interaction of high-energy muons. The study of muons of higher energies than several Gev entails the use of devices with substantial increase in transmissivity. This was obtained by the magnetic spectrometer method. The discussion centers on energy release spectra of muons interacting with thick layers of matter. Most of the studies described here were conducted in the USSR and they are illustrated by a series of diagrams and sketches of the devices used. Author

N70-20598# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
HIGH ENERGY ELECTRONS IN SOLAR FLARES
Y. Koechlin, A. Raviart, L. Treguer, C. J. Bland (Milan Univ.), G. Degli Antoni (Milan Univ.) et al [1969] 15 p refs Presented at the 11th Intern. Conf. on Cosmic Rays, Budapest, 25 Aug.-4 Sep. 1969
(CEA-CONF-1402; CONF-690814-5) Avail: CFSTI

An electron detector capable of registering electrons of energy greater than 10 MeV has been in orbit on the ESRO eccentric satellite HEOS A1 (apogee 220,000 km) since December 5, 1968. During this period, an excess of electrons above the undistributed level has been observed during solar flares. The rise time and decay of these electrons are examined in relation to the flare parameters, for the flares of February 25, and of March 30. Author (NSA)

N70-20793# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SIMULTANEOUS SATELLITE AND ROCKET OBSERVATIONS OF THE 25th FEBRUARY 1969 SOLAR PROTON EVENT
E. Barouch, J. Engelmann, M. Gros, L. Koch, and P. Masse 1969 17 p refs Presented at the 11th Intern. Conf. on Cosmic Rays, Budapest, 25 Aug. - 4 Sep. 1969
(CEA-CONF-1405; CONF-690814-2) Avail: CFSTI

Energy spectra and time dependence of the particle flux following the proton flare of February 25, were measured by detectors aboard IRIS and HEOS and on two rockets fired from Andenes during the mild PCA that followed this event. These measurements permit a study of cosmic-ray propagation in the region of interplanetary space closest to the earth to be carried out in some detail. Author (NSA)

N70-20932# Iowa Univ., Iowa City.
ALPHA PARTICLE EMISSIVITY OF THE MOON: AN OBSERVED UPPER LIMIT
Richard S. Yeh and James A. Van Allen Jul. 1969 26 p refs
(Contract Nonr-1509(06))
(AD-695398; Rept-69-38) Avail: CFSTI CSCL 20/8

By means of observations with the moon-orbiting spacecraft Explorer 35 during 1967-1968, we find it unlikely that the alpha particle emissivity of the moon is greater than 0.064/square centimeters sec sr to the minus 1 and exceedingly unlikely that it is greater than 0.128, these values being respectively 0.1 and 0.2 of provisional estimates by Kraner et al. in 1966. This result implies that the abundance of 92U238 in the outer crust (nearly equal to a few meters in thickness) of the moon is very much less than that typical of the earths lithosphere, though it is consistent with the abundance of 92U238 in terrestrial basalt or in chrondritic meteorites. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-19725*# IIT Research Inst., Chicago, Ill.
SPECTROSCOPIC OBSERVATIONS OF THE PLANETS Final Report
T. Owen Dec. 1969 11 p refs
(Contract NASw-1863; Proj. V6097)
(NASA-CR-108240) Avail: CFSTI CSCL 03B

Recent data on the atmospheres of Jupiter, Venus, and Mars are presented. Spectrometric studies of Venus revealed a new carbon dioxide band at 7105 A and no evidence for emission from the light side of the planet or water vapor absorptions was found. The value for precipitable water abundance in the Martian atmosphere was calculated to be about 35 microns, and the increase over previous determinations is attributed to increased instrumental resolution. The 5500 A ammonia line and the upper limit on D/H in the Jovian atmosphere were studied with inconclusive results. A methane band was observed at the center and limb, indicating limb temperature of 30 to 40 degrees cooler than the center of the disk. N.E.N.

N70-19726*# Stanford Research Inst., Menlo Park, Calif.
LABORATORY CO2 PHOTOLYSIS STUDIES RELATED TO PLANETARY ATMOSPHERES Semiannual Report, 15 Jul. 1969-15 Jan. 1970
Tom G. Slanger 10 Feb. 1970 4 p refs
(Contract NSR-05-019-252; SRI Proj. PAU-8162)
(NASA-CR-108244) Avail: CFSTI CSCL 03B

Initial results in observing oxygen and carbon dioxide UV photolysis are briefly described. A lamp emitting 1302-1306 A was constructed for measuring O(3P) concentrations by means of resonance fluorescence. Data indicate that O(3P) is produced with a quantum yield of 1.0, the O(1D) is removed by adding hydrogen to carbon dioxide without affecting the O(3P), and loss rates of O(3P) in presence of carbon dioxide and oxygen are governed by the pump-out time of the system. N.E.N.

N70-19919# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astron., and Space, No. 219 2 Jan. 1970 p 1-6 refs (See N70-19918 08-13)
Avail: CFSTI

Abstracts of articles on instruments for radio telescopes are presented. Parabolic antennas, radiometers, parametric amplifiers, radio spectrometers, and interferometers are included, along with associated measuring techniques. N.E.N.

N70-20064*# National Aeronautics and Space Administration, Washington, D.C.
REPORT TO COSPAR, FRENCH SPACE PROGRAM
Feb. 1970 149 p refs Transl. into ENGLISH from the French Presented at the French Space Program 12th Meeting, Prague, May 1969
(NASA-TT-F-12725) Avail: CFSTI CSCL 22B

CONTENTS:

1. PHYSICS OF THE IONOSPHERE AND OF THE MAGNETOSPHERE p 1-22 refs (See N70-20065 08-13)
2. AERONOMY AND METEOROLOGY p 23-46 refs (See N70-20066 08-20)
3. THE PHYSICS OF PARTICLES AND OF COSMIC RAYS p 47-63 refs (See N70-20067 08-29)
4. ASTROPHYSICS AND ASTRONOMY p 64-80 refs (See N70-20068 08-30)
5. TRAJECTOGRAPHY AND GEODESY p 81-88 refs (See N70-20069 08-30)
6. BIOLOGY p 89-96 refs (See N70-20070 08-04)
7. SPACE GEODESY IN FRANCE J.-C. Husson p 96-141 refs (See N70-20071 08-30)

N70-20068*# National Aeronautics and Space Administration, Washington, D.C.
ASTROPHYSICS AND ASTRONOMY
In its Rept. to COSPAR, French Space Program Feb. 1970 p 64-80 refs (See N70-20064 08-30)
Avail: CFSTI CSCL 03B

Several important aspects of astrophysics and astronomy are discussed. Of chief interest are the following topics: double emission of ionized magnesium at 2800 A, neutral carbon ray at 1993.6 A, helium resonance ray at 584 A, solar radiation in the Lyman alpha ray of hydrogen, continuous solar emission below 3000 A, infrared solar spectroscopy between 12 and 24 microns, solar astronomy, stellar and nebular program, interplanetary diffusion program, and other experiments. Author

N70-20069*# National Aeronautics and Space Administration, Washington, D.C.
TRAJECTOGRAPHY AND GEODESY
In its Rept. to COSPAR, French Space Program Feb. 1970 p 81-88 refs (See N70-20064 08-30)
Avail: CFSTI CSCL 03B

The following important topics are discussed: the Diademe program, geometric analysis of the data, reduction of Doppler observations, visual and photographic observations, photometry, and photography of laser echoes on satellites. Author

N70-20071*# National Aeronautics and Space Administration, Washington, D.C.
SPACE GEODESY IN FRANCE
J.-C. Husson *In its* Rept. to COSPAR, French Space Program Feb. 1970 p 96-141 refs (See N70-20064 08-30)
Avail: CFSTI CSCL 03B

The French space geodesy program is concentrated on two plans: experimental, by setting up earth and space equipment, and theoretical, by elaborating very complex calculus programs, for the interpretation of measurements. The geodesy space projects include: participation in international programs (GEOS, West European, Pageos), the national program (Echo 1 and 2, the D-1 program, the RCP 133 program -- Eurafrican 1968). The results obtained in space geodesy are limited to four areas: geometrical geodesy, semidynamic geodesy, orbital geodesy and dynamic geodesy. Author

N70-20082 California Univ., Los Angeles.
PREDICTION OF THE POSITION AND VELOCITY OF A SATELLITE AFTER MANY REVOLUTIONS
Saterios Sam Dallas (Ph.D. Thesis) 1968 631 p
Avail: Univ. Microfilms: HC $28.60/Microfilm $8.00 Order No. 69-7239

It is shown that the methods of general perturbations are ideally suited for the prediction of orbits extending over many periods. The mathematical foundations for a theory of general perturbations using either the variation of coordinates or the variation of parameters each with multivariable asymptotic expansions as well as a theory of general perturbations using the variation of parameters with Taylor's series expansions are presented. Five theories of general perturbations are applied to the elementary problem of the damped linear harmonic oscillator. These applications illustrate the mathematical processes involved as well as the advantages and disadvantages of each theory. It is shown that the variation of coordinates and the variation of parameters each with multivariable asymptotic expansions are the only theories from this group that will yield the superior, uniformly valid approximation. Dissert. Abstr.

N70-20200# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
QUASAR MODELS AND NEBULAE Status Report, 1 Jan. - 31 Oct. 1969
T. Gold Nov. 1969 10 p refs
(Contract N00014-67-A-0077-0007)
(AD-698206; CRSR-355) Avail: CFSTI CSCL 3/2

The document is a status report for work in the areas of pulsating radio sources, quasars, and radio galaxies. TAB

N70-20209 Ohio State Univ., Columbus.
A METHOD FOR EXTRACTING RADIO ASTRONOMICAL INFORMATION FROM NOISE, ON A PRODUCTION LINE BASIS, AND ITS APPLICATION TO A HIGH SENSITIVITY 1415 MHz CONTINUUM SURVEY BETWEEN RIGHT ASCENSIONS 0h TO 16h AND DECLINATIONS +20 DEG TO +37 DEG
Robert Stanley Dixon (Ph.D. Thesis) 1968 282 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 69-4873

A method has been developed for extracting weak radio astronomical signals from noise in a systematic and unbiased way, thereby allowing detection and parameter measurements of a large number of previously unknown radio sources. The method makes extensive use of digital computers, requires little human intervention, and is designed to handle large volumes of data on a production line basis. Right ascension drift scans obtained with the Ohio State University Radio Observatory 360 foot meridian transit radio telescope are recorded digitally on punched tape and subsequently converted to cards by an IBM 1620 computer. This computer also performs several editing and checking procedures and prepares data plots on a 30-inch wide Cal Comp incremental plotter. The data is then passed through a sequence of programs on an IBM 7094 computer, with plots being made and inspected at each stage. Dissert. Abstr.

N70-20237*# Geological Survey, Washington, D.C.
INTERAGENCY REPORT: ASTROGEOLOGY 19: STRATEGY FOR THE GEOLOGIC EXPLORATION OF THE PLANETS
M. H. Carr, ed. 1969 110 p refs

(NASA Order W-12650)
(NASA-CR-108783) Avail: CFSTI CSCL 03B

The purpose of this document is to provide a guide to the orderly geologic exploration of the planets, to assign priorities to specific experiments and to suggest areas where supporting Earth-based research can be most profitably pursued. The kinds of data that are most relevant to geologic interpretation are specified and the sequence in which these data should be acquired is outlined. Author

N70-20246# Air Force Cambridge Research Labs., Bedford, Mass.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 6, NO. 2 Quarterly Report, 1969
Anne L. Carrigan 1969 298 p
(AD-695812; QR-2) Avail: CFSTI CSCL 3/2

Contents: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Extremely low frequency noise; Riometer; Solar optical patrol observations; Solar radio emission; and Vertical incidence ionospheric soundings. TAB

N70-20301# Sandia Corp., Albuquerque, N.Mex.
TRAJECTORIES AND REENTRY ENVIRONMENTS FOR THE ALRH DURING MULTIPLE REVOLUTION HIGHLY ELLIPTICAL ORBITAL DECAY AFTER SUPERCIRCULAR VELOCITY REENTRY
H. R. Spahr Aug. 1969 286 p refs Sponsored by AEC
(SC-RR-69-360) Avail: CFSTI

Trajectories and reentry environments are presented for the Apollo Lunar Radioisotope Heater (ALRH) during multiple revolution highly eliptical orbital decay after shallow angle supercircular velocity reentry. The trajectories and reentry environments from a closed form approximate solution and from numerical integration of the equations of motion are compared for two of the five perigee altitudes investigated. Author (NSA)

N70-20321# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED ORBIT/EPHEMERIS SUBSYSTEM (AOES): TIME TRANSFORMATION REVIEW
Charles M. Randall 30 Jul. 1969 77 p refs
(Contract F04701-69-C-0066)
(AD-697781; SAMSO-TR-69-361; TR-0066(5110-01)-1) Avail: CFSTI CSCL 22/3

The space-time reference frame most convenient for the calculations of satellite ephemerides is not, because of the earths motion, the most convenient reference frame in which satellite positions may be measured by an observer on the earth. Integration of the equations of motion describing the satellite motion is most conveniently carried out in an inertial coordinate system, while observation is most conveniently carried out in a coordinate system fixed with respect to the surface of the earth. Transformation from the inertial to the earth fixed systems and vice-versa is a straightforward, though often tedious, computational exercise. This transformation requires a knowledge of the earths motion with accuracy commensurate with the accuracy required from the transformation. The present report concentrates attention on the coordinate systems and transformation schemes employed by the Advanced Orbit/Ephemeris Subsystem (AOES) computer programs presently being implemented by the Air Force Satellite Control Facility. The relations between the time scales employed by it and the computation of time dependent inputs to the spatial transformation procedures of AOES are reviewed. The basic equations are presented and the numerical constants appearing in the programs are evaluated. Author (TAB)

N70-20386*# New Mexico State Univ., Las Cruces. Observatory.
PHOTOGRAPHIC OBSERVATIONS OF JUPITER IN 1968-1969
E. J. Reese Jan. 1970 17 p refs
(Grants NGL-32-003-027; NGL-32-003-001)
(NASA-CR-108903) Avail: CFSTI CSCL 03A

Latitude measurements were made of the Jovian belts during the apparition of Jupiter in 1968-69. These measurements were made from photographic observations of the events that took place in the South Equatorial Belt, South Tropical Zone, and the South Temperate Zone. Small bright spots surrounded by dark penumbral-like shadings were observed in the South Temperate Zone, while the South Equatorial Belt was thin and faint. Latitude measurements are summarized in tabular form. J.M.C.

N70-20438*# Harvard Coll. Observatory, Cambridge, Mass.
SOLAR XUV LIMB BRIGHTENING OBSERVATIONS AND INTERPRETATION
George L. Withbroe Nov. 1969 37 p refs
(Contract NASw-184)
(NASA-CR-108916; TR-13) Avail: CFSTI CSCL 03B

OSO-IV observations of the equatorial limb brightening of XUV resonance lines of N V, O VI, Ne VIII, Mg X and Si XII are interpreted with a modified version of a coronal model developed by Dupree and Goldberg (1967). Good agreement is obtained between the observed limb brightening and that predicted by the model. The sensitivity of the predicted limb-brightening curves to changes in parameters describing the model is discussed. Coronal abundances for N, O, Ne, Mg, and Si are obtained. Author

N70-20473*# Stanford Univ., Calif. Radioscience Lab.
STANFORD TELEMETRY MONITORING EXPERIMENT ON LUNAR EXPLORER 35 Final Report
G. L. Tyler, D. H. H. Ingalls, and P. A. Simpson Oct. 1969 86 p refs
(Contract NAS5-9347)
(NASA-CR-108901; SU-SEL-69-066) Avail: CFSTI CSCL 03B

A partial analysis of the Explorer 35 experimental data is discussed. The effects of lunar surface shapes were separated from those of the material composition. The bulk electromagnetic properties of the lunar crust were determined. Variable earth based observations of lunar electromagnetic properties were resolved in terms of the regional geological moon structure. The occulation study and antenna pattern interpretation problems were also noted. Author

N70-20517*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE PROCESSING AND MANUFACTURING
5 Feb. 1970 554 p refs
(NASA-TM-X-53993) Avail: CFSTI CSCL 22A

Production engineering aspects of materials processing and industrial manufacturing are discussed with application to orbiting laboratories and orbital workshops. Analyzed are especially the effects of reduced gravity or weightlessness on production processes. For individual titles, see N70-20517 through N70-20548.

N70-20518*# National Aeronautics and Space Administration, Washington, D.C.
EARTH ORBITAL PAYLOAD PLANNING
William O. Armstrong *In its* Space Process. and Manufacturing 5 Feb. 1970 p 10-40 (See N70-20517 08-30)
Avail: CFSTI CSCL 22A

Processing and manufacture of materials in orbit is shown as one of the more promising elements of future earth orbital payloads. Plans for including it in the experiments program of the next decade are outlined and compared with preliminary planning for flight programs in this period. Space vehicles such as the AAP Workshops, the Space Station and the Shuttle are described and related to program planning for processing and manufacture of materials in orbit. Some of the major milestones in the evolution of such a program are also described. Procedures for soliciting and selecting industrial inputs are reviewed and some policy guidelines related to funding and proprietary rights of involved industrial organizations are considered. Author

N70-20592*# Rice Univ., Houston, Tex. Dept. of Space Science.
ALIGNMENT OF OBLIQUE ROTATORS
F. Curtis Michel and H. C. Goldwire, Jr. [1969] 15 p refs
(Grant NGL-44-006-033)
(NASA-CR-108982) Avail: CFSTI CSCL 03B

Pulsars slowed down by radiation field torques are discussed, with an accompanying torque that aligns the magnetic moment with the spin axis. The general implication of the alignment effect is that most pulsars would be formed either with periods not too different from what are now observed or with magnetic moments almost precisely orthogonal to the spin axis. Alternatively, neutral sheet formation in the pulsar magnetosphere, or other plasma effects, was found to suppress the alignment torque. Author

N70-20757# Stanford Univ., Calif. Inst. for Plasma Research.
EXPLOSIONS IN GALAXIES AND QUASARS
P. A. Sturrock Jan. 1969 41 p refs
(Contract N00014-67-A-0112-0006)
(AD-697671; SU-IRP-272) Avail: CFSTI CSCL 3/2

The paper discusses the mechanism of explosions in radio galaxies and quasars. The similarity between these explosions and solar flares are noted, and galactic flare models are presented. TAB

N70-20814*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
MASS CONCENTRATIONS IN THE LUNAR INTERIOR [MASSENKONZENTRATIONEN IM MONDINNEREN]
R. Engel Washington NASA Feb. 1970 6 p Transl. into ENGLISH from Weltraumfahrt Raketentech., v. 20, Jul.-Aug. 1969 p 99-102
(Contract NASw-1692)
(NASA-TT-F-12866) CSCL 03B

A discussion of lunar orbiter data indicating the existence of unequal mass distributions in the lunar interior is presented. This hypothesis was confirmed by the manned Apollo 8 and Apollo 10 flights. New theories on the origin and history of the moon based on the existence of mass concentrations in its interior are discussed. Author

N70-20823*# Columbia Univ., Palisades, N.Y. Lamont-Doherty Geological Observatory.
DEVELOPMENT OF A LUNAR HEAT FLOW EXPERIMENT FOR ALSEP Quarterly Progress Report, Oct. - Dec. 1969
Marcus G. Langseth, Jr. Dec. 1969 78 p
(Contract NAS9-6037)
(NASA-CR-108277; QPR-2) Avail: CFSTI CSCL 03B

Preparation for reduction of the data from the Apollo 13 heat flow experiment is reported. Theoretical investigations of the transient heat flow induced into the lunar subsurface are discussed. A detailed analysis is contained of the problem of heat flowing down the interior of the borehole by radiation due to a periodic fluctuation at the top of the borehole. A statistical study of craters within typical areas of the landing ellipse was conducted to establish the maximum distance in terms of crater diameters in which the astronauts could be expected to place the heat flow probes. This analysis suggested it is relatively easy to find an area approximately 1.5 diameters from the rim of craters of any crater greater than 2 meters but less than 21 meters in diameter, and it would be difficult to meet a criteria of 2.0 diameters from the rim of all craters. Author

N70-20838*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
MOON: OPTICAL PROPERTIES OF APOLLO 11 SAMPLES
B. O'Leary and Frank Briggs Jan. 1970 20 p refs Submitted for publication
(Contract NAS9-8018)
(NASA-CR-108282; CRSR-364) Avail: CFSTI 03B

Lunar powder samples returned by Apollo 11 are remarkably similar in their optical properties to those measured for a several km2 area surrounding Tranquility Base, suggesting a ubiquitous covering of the same material in the region. However, there are minor exceptions to the close match: the powder sample shows larger polarizations and a larger opposition effect than would be expected from previous observations. In the spectrum of the lunar rock samples, a strong, broad absorption near 1 micron and a weaker band > or = to 1.8 micron were detected, which may be due to orthopyroxenes in the presence of other iron-bearing silicates. The 1-micron band was absent in the powder sample (presumably because the particle sizes were too small), which suggests that the spectrophotometer may become a valuable tool in distinguishing between rocky and dusty areas on the Moon. Author

N70-20853*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE ESCAPE OF LIGHT FROM WITHIN A MASSIVE STAR
Jack Jaffe [1969] 23 p refs
(Grant NGL-22-009-019)
(NASA-TM-X-62816) Avail: CFSTI CSCL 03B

The escape of light from within spehrically symmetric gravitational masses is analyzed. It is found that there exist models where a portion of the light emitted inside a star does not escape past the surface; only light within a certain, variable escape cone leaves the star. This escape cone does not steadily shrink with decreasing radius of emission, unlike the somewhat analogous cone effect for light in an external spherically symmetric field. Author

N70-21015# California Inst. of Tech., Pasadena.
THE ROLE OF NEUTRONS IN ASTROPHYSICAL PHENOMENA
William A. Fowler 1969 25 p refs
(Contract Nonr-220(47); Grant NSF GP-7976)
(AD-697695) Avail: CFSTI CSCL 3/2

Although work has been by Macklin and Gibbons at Oak Ridge on neutron capture cross sections in the 1 to 100 keV range for application to the s-process of nucleosynthesis in stars, much research in this and related fields is still needed. At Los Alamos, Seeger has continued his important studies of the unstable neutron-rich nuclei but more experimental and theoretical work is required to reach an understanding of the r-process of nucleosynthesis. At Rice University, Clayton has analyzed the empirical data needed to reach a more complete understanding of the chronology of nucleosynthesis in the Galaxy. At the California Institute of Technology, studies continue on reactions such as C13(Alpha,n) which serve as sources of neutrons in stars. The situation as of March, 1968 is reviewed with especial emphasis being placed on the correlation of astrophysical and geochemical observations with predictions based on experiment and theory in neutron physics. Author (TAB)

N70-21061# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
REENTRY VEHICLE DISPERSION DUE TO ATMOSPHERIC VARIATIONS
Reinald G. Finke Aug. 1969 50 p refs
(Contract DAHC15-67-C-0011)
(AD-697925; P-506; IDA/HQ-69-10761) Avail: CFSTI CSCL 16/3

Reentry vehicle impact displacements due to a fixed perturbation in density or in wind speed in each 5-km-thick layer of the atmosphere up to 90-km altitude were derived from a series of machine reentry-trajectory calculations with the program RANGE for different R/Vs and reentry conditions. Three arbitrary reentry vehicle shapes were chosen whose ballistic coefficients (550, 1025, and 1975 lb/sq ft) were representative of the range of interesting values. Reentry conditions were varied, from those of IRBMs of 15,000 ft/sec at 50-deg path angle, to those for ICBMs of 22,500 ft/sec at 20-deg path angle, and reentry azimuths were varied from direct equatorial (tail wind) to retrograde equatorial (head wind). Intermediate reentry conditions were included to define

the dependences well enough for interpolation, and even slight extrapolation, to all known interesting combinations. The resulting layer-wise miss contributions from the most influential 5-km layers (centered at 5- and 10-km altitude) vary from about 200 ft for 1 percent change in density. Author (TAB)

N70-21101*# Harvard Coll. Observatory, Cambridge, Mass.
MEASUREMENTS OF THE VAN DER WAALS Na-lambda 5889 in He WITH A NEWLY DEVELOPED PISTON COMPRESSOR LIGHT SOURCE
Jonathan E. Grindlay Oct. 1969 93 p refs
(Grant NGL-22-007-006; Contract N00014-67-A-0298)
(NASA-CR-108983; SR-31) Avail: CFSTI CSCL 03B

A review of the theory of neutral atom broadening in the impact approximation and quasi-static limits is given. The impact approximation is considered in detail and a new calculation for the line width is presented. A new source of approximately 5000 K helium and (eventually) hydrogen has been developed, using a rapid compression technique. The final (compressed) gas conditions for this piston compressor have been calculated and found to agree approximately with measured values of pressure, temperature, and density. Techniques have also been developed to measure electron densities in this source. The source was used to enable rapid scanning Fabry-Perot measurements of Na5889A in He at approximately 4500 K. The measurements showed the broadening approximately 4.5 greater than the Van der Waals impact approximation prediction. The implications of these results for the astrophysically important case of Fraunhoffer line broadening in hydrogen are discussed. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-19797*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
PREDICTION OF STRUCTURAL DAMPING FOR FUTURE SATURN FLIGHTS Final Report, 26 Jun. 1968-31 Dec. 1969
W. E. Jones, Jr. Dec. 1969 138 p refs
(Contract NAS8-21446)
(NASA-CR-102463; LMSC/HREC-D149346; HREC-1446-1) Avail: CFSTI CSCL 22B

Structural damping was considered to be the damping due to internal energy dissipations in the material and the energy losses due to joint friction. The results are presented as modal damping coefficients for several low-frequency modes of vibration. The AAP cluster configuration consists of the S-4B orbital workshop (OWS), airlock module (AM), and multiple docking adapter (MDA), with the command service module (CSM) docked at the end port of the MDA and the lunar module/apollo telescope mount (LM/ATM) docked at a lateral port. The ATM solar panels are deployed. The mode shapes and frequencies were obtained using the cluster dynamics computer program. The AAP structural damping is the energy dissipated in the ATM solar panel arrays, ATM canister rings, MDA structure and the docking port joints connecting the CSM and LM/ATM to the MDA. The material damping occurs in the ATM solar panel structure, MDA structure, and ATM canister rings. The joint damping occurs in the ATM solar panel joints and the joints in the MDA longitudinal and radial docking ports. Author

N70-19841*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT. VOLUME 1: PIONEER 6, PRELAUNCH TO END OF NOMINAL MISSION
N. A. Renzetti 1 Feb. 1970 151 p refs
(Contract NAS7-100)
(NASA-CR-108770; JPL-TM-33-426) Avail: CFSTI CSCL 22A

The Pioneer 6 mission (inward trajectory, heliocentric orbit) employed six scientific instruments to accumulate information relative to interplanetary high-energy particles, solar phenomena, and plasma. The spacecraft also served as a celestial mechanics experiment reference point. The tracking and data system tracked the spacecraft from launch through near-earth and deep space phases. For near-earth tracking, all tracking and data system facilities responded to mission, launch vehicle, and range requirements. For deep space tracking, the deep space network responded to tracking, telemetry, command, monitoring, simulation, and operations calculation requirements. Author

N70-19872*# ITT Aerospace/Optical Div., Fort Wayne, Ind.
RADIANT COOLER DESIGN AND EMISSIVITY STUDY, PART 1: RADIANT COOLER DESIGN Final Report, 8 Apr.-31 Oct. 1969
31 Oct. 1969 69 p refs
(Contract NAS-5-11683)
(NASA-CR-108767) Avail: CFSTI CSCL 22B

This part of the report covers the design and thermal analysis of a single stage radiant cooler for operation from one side of a Nimbus spacecraft. The cooler is designed to attain a temperature in the 90 K to 100 K range at a minimum launch of 500 n mi and a maximum base temperature of 35 C over the range of orbital plane to earth-sun line angles from 0 degrees to 15 degrees. Reasonable but relatively large changes in the thermal parameters of the design do not produce correspondingly large changes in the cooler temperatures. The thermal analysis of the radiant cooler is based on techniques employing the specular image model. These techniques are generally applicable to the design and analysis of any radiant cooler with rectangular geometry. Author

N70-20093*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A SYSTEMS ENGINEERING DECISION ALGORITHM WITH APPLICATION TO APOLLO APPLICATIONS PROGRAM INTEGRATION PROBLEMS
C. E. De Sanctis 2 Feb. 1970 118 p refs
(NASA-TM-X-53992) Avail: CFSTI CSCL 22B

A decision algorithm, that has been specifically adapted to the needs of the System Engineer, is presented for resolving complex Apollo Applications Program (AAP) technical and management integration problems. An explanation of decision theory as applied to a technical problem and a detailed example of how the decision algorithm was used to determine the best location for the scientific airlock in either the orbital assembly's airlock module structural transition section, or the multiple docking adapter is submitted. It is concluded that alternate position number 1, located on the structural transition section, be chosen to resolve the AAP technical,operational, and management requirement problems. Further, it is concluded that the decision algorithm can be used to address many complex systems engineering problems requiring timely and accurate decisions. Author

N70-20112# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DODGE GRAVITY-GRADIENT BOOM THERMAL BENDING EXPERIMENT
R. A. Mattey and J. F. Smola Aug. 1969 23 p
(Contract NOw-62-0604-c)
(AD-697905; APL-TG-1079) Avail: CFSTI CSCL 22/2

Results of DODGE satellite gravity-gradient boom thermal bending experiments conducted in orbit are discussed. Included are photographs showing boom curvature induced by the temperature gradient around the periphery of the boom tape. Plots of end mass positions indicate the extent of thermal bending that was

experienced during the first experiment when the satellite was not gravity-gradient captured and during the second experiment when the satellite motion was relatively calm. Author (TAB)

N70-20417*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
PROPELLANT SLOSH COUPLING WITH BENDING Final Report
G. C. Feng and D. L. Grady Dec. 1969 127 p refs
(Contract NAS8-21485)
(NASA-CR-102487; HREC-1485-2; LMSC/HREC-D149410) Avail: CFSTI CSCL 22B

A new approach which employs the combined system modes instead of the bending and slosh modes separately in formulating the mathematical model of a liquid propellant vehicle is used to simulate the atmospheric flights of formulating Saturn V vehicle. The model includes two rigid-body motions, four system bending modes and a control system with high-order control dynamics. The aerodynamic forces, thrust, gravitational field and vehicle vibrational characteristics which are functions of flight time are represented by 21 time-varying coefficients. Propellant slosh forces and slosh amplitudes may be calculated after the responses of the vehicle are obtained. An associated hybrid computer program was developed. The program uses the analog computer to perform the numerical integration of the system and the digital computer to compute and store the response parameters of the system when subjected to a large ensemble of wind samples. At the end of the first passage of the program, the mean values of the response parameters are calculated. The statistics of the wind and vehicle first passage are computed in the second passage of the program. Author

N70-20489*# North American Rockwell Corp., Los Angeles, Calif.
ONE-MAN LUNAR FLYING VEHICLE PROGRAM STUDY
[1969] 28 p *Its* Letter No. 69MA625
(Contract NAS9-9045)
(NASA-CR-102182) Avail: CFSTI CSCL 22B

An outline, and schedule of the overall approach to the study program is presented. The study is divided into parametric and design phases. The study tasks include design of the following: configuration, propulsion system, control system, and payload. F.O.S.

N70-20512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT PERFORMANCE OF ATLAS-CENTAUR AC-13, AC-14, AC-15 IN SUPPORT OF THE SURVEYOR LUNAR LANDING PROGRAM
Washington Feb. 1970 244 p refs
(NASA-TM-X-1844; E-5057) Avail: CFSTI CSCL 22D

Atlas-Centaur launch vehicles AC-13, AC-14, and AC-15 successfully boosted Surveyors 5, 6, and 7, respectively, into lunar intercept trajectories. These launch vehicles used the indirect (two-burn) mode of ascent. Surveyor 7 launched on January 7, 1968, concluded the Surveyor lunar landing program. The flight performance of the AC-13, AC-14, and AC-15 launch vehicles from lift-off through Centaur retromaneuver is discussed. Author

N70-20530*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FACILITY FOR SPACE EXPERIMENTS M512 AND M479
P. G. Parks *In its* Space Process. and Manufacturing 5 Feb. 1970 p 252-261 (See N70-20517 08-30)
Avail: CFSTI CSCL 22B

The capability for conducting space manufacturing experiments during an earth-orbital mission are contained within a completely integrated system. This versatile system provides the facility for conducting six (6) experimental tasks and consists of a vacuum work chamber, a control panel and a 2 kilowatt electron beam welding and heating system. This experimental facility is shock mounted on a vibration dampening panel and attached to the Multiple Docking Adapter longerons in a vertical position. The work chamber is vented through the outer wall to provide a vacuum of 2×10 the the minus 4th power torr required for the experiments. Author

N70-20590*# GCA Corp., Bedford, Mass. Technology Div.
SPLIT PAYLOAD HOUSING NOSE CONES, DOORS, AND RELEASE MECHANISMS Final Report
V. J. Guarino Nov. 1968 30 p
(Contract NAS9-8232)
(NASA-CR-108273; GCA-TR-68-17-N) Avail: CFSTI CSCL 22B

A nosecone separation system and a door-ejection system adaptable to a standard Nike Apache payload housing is described. The system will be used in conjunction with a sounding rocket experiment in which various photometric instrumentation will be exposed at prescribed altitudes. The various engineering drawings and photographs applicable to the split nosecone and door-release systems are presented. In addition, the installation, servicing and operating instructions are provided in some detail. An acceptance test plan and inspection procedure to insure system reliability is included. Author

N70-20638# Aerospace Corp., El Segundo, Calif.
PROCEEDINGS OF THE SYMPOSIUM ON GRAVITY GRADIENT ATTITUDE STABILIZATION
5 Sep. 1969 477 p refs Symp. held 3-5 Dec. 1968
(Contract F04701-69-C-0066)
(AD-696694; TR-0066-5143-1; SAMSO-TR-69-307) Avail: CFSTI CSCL 22B

These proceedings contain copies of the papers presented at the Symposium on Gravity Gradient Attitude Stabilization held on 3 - 5 December 1968. The symposium was broken into seven sessions. Session I, the Role of Gravity Gradient Attitude Control for Future Spacecraft, is devoted to the subject of representative attitude control requirements for spacecraft missions in planning. Session II, Space Environment, contains two papers: the first is on the magnetic field and the second is on particle environment--at synchronous altitude. Session III, Theory, contains papers on the completeness of theory relating to the design and anticipated performance of gravity gradient systems. Session IV, Design and Operational Experience, presents operational and design experience for existing gravity gradient spacecraft. Session V, Hardware, concentrates on the characteristics, performance, and state of development of existing and projected principal elements of gravity gradient systems. Session VI, New Concepts, is devoted to descriptions of new gravity gradient techniques that will be useful for future satellites. Session VII, the Panel Discussion, contains an edited transcription of the panel discussion. Author (TAB)

N70-20639*# Boeing Co., Seattle, Wash. Aerospace Group.
BURNER 2/IMPROVED CENTAUR INTEGRATION STUDY. VOLUME 1: TECHNICAL Final Report
Jan. 1970 191 p refs
(Contract NAS3-11803)
(NASA-CR-108978; D2-116103-Vol-1) Avail: CFSTI CSCL 22D

This document is the final report of a Burner II/Centaur integration study. The material herein deals with all aspects of integrating the Burner II flight stage with a payload, the Improved Centaur (Centaur E with 60 minute coast capability) and the Titan I.T.L. launch facilities at E.T.R. Author

N70-20640*# Boeing Co., Seattle, Wash. Aerospace Group.
BURNER 2/IMPROVED CENTAUR INTEGRATION STUDY. VOLUME 2: COSTS AND SCHEDULES Final Report
Jan. 1970 50 p
(Contract NAS3-11803)
(NASA-CR-108981; D2-116103-Vol-2) Avail: CFSTI CSCL 22D

The planning costs and schedule for the integration of the Burner II with the Titan III/Improved Centaur launch vehicle (Centaur E with 60 minute coast capability) are given. The document also includes a summary of the technical portion of the final report and the ground rules which provided the basis for the costs and schedules. Author

N70-20730*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-59, VOLUME 3 FOR THE PERIOD 1 AUGUST TO 30 SEPTEMBER 1969. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Oct. 1969 274 p refs
(Contract NAS7-100)
(NASA-CR-108969; JPL-SPS-37-59-Vol-3) Copyright. Avail: CFSTI CSCL 22B

A summary of research and developments in current scientific work of the Jet Propulsion Laboratory for August and September 1969 is presented. Included are developments in: space and environmental sciences, telecommunications, propulsion, and mechanical engineering. F.O.S.

N70-20751*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
MARINER VENUS 67 POWER SUBSYSTEM MODIFICATION: TEST AND FLIGHT OPERATION
A. Krug 30 Jun. 1969 42 p
(Contract NAS7-100)
(NASA-CR-109033; JPL-TM-33-423) Avail: CFSTI CSCL 22B

Spare spacecraft originally designed for the Mariner Mars 1964 mission were modified to accomplish the successful Venus flyby of Mariner V. The changes necessary to the power subsystem of that spacecraft to adapt it for the Venus mission are described. Flying toward rather than away from the sun affected the design of the primary power source - the solar panels. The panels were required to accommodate temperatures in excess of 120 C, and to supply power within a voltage range compatible with the power conditioning equipment. Thermal interactions between the solar panels and the spacecraft mechanical bus also affected the design. The power conditioning equipment design was affected by the scientific instrument package which was flown, and the entirely new sequence of operations at planet encounter. The power conditioning equipment was redesigned, therefore, to provide the increased power handling capability required by the spacecraft loads, and the revised switching of the power distributed to the scientific instrument package. The test, operations, and flight of the Mariner Venus 67 power subsystem were extremely successful; a minimum of difficulties were encountered. Author

N70-20806*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: CONDENSED SUMMARY REPORT
Jan. 1970 28 p refs
(Contract NAS9-9046)
(NASA-CR-108285; D2-113070-4) Avail: CFSTI CSCL 22B

The Space Station Safety Study summarized in this document was performed during 1969 as one of a series of studies of space safety conducted by or for NASA. The emphasis of this study was directed primarily toward defining measures which would tend to prevent, or reduce the probability of, occurrence of an emergency or hazardous condition. The safety measures defined are expressed as a set of Crew Safety Guidelines which are published in their entirety, together with appropriate cross-references. The guidelines may be used as a checklist with which to evaluate the safety measures included in, or omitted from, a spacecraft design. However, a more valuable application would appear to be the use of the guidelines to develop space station or base concepts in which crew safety is the primary consideration. Some attention was devoted to problems of spacecraft damage containment and control and a set of guidelines which are pertinent to that subject have been identified. Author

N70-20807*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: CREW SAFETY GUIDELINES, VOLUME 1
Jan. 1970 191 p refs
(Contract NAS9-9046)
(NASA-CR-108286; D2-113070-5-Vol-1) Avail: CFSTI CSCL 22B

The basic arrangement of the Crew Safety Guidelines is by hazard groups, with each guideline appearing only once. Cross-indexes are provided which relate each guideline to other hazard groups if appropriate, to subsystems affected by the hazard, to key words, and to damage containment and control procedures. Author

N70-20808*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: CREW SAFETY GUIDELINES, VOLUME 2
Jan. 1970 401 p refs
(Contract NAS9-9046)
(NASA-CR-108288; D2-113070-5-Vol-2) Avail: CFSTI CSCL 22B

For abstract see N70-20807.

N70-20809*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: SUPPORTING ANALYSIS
Jan. 1970 205 p refs
(Contract NAS9-9046)
(NASA-CR-108290; D2-113070-6) Avail: CFSTI CSCL 22B

These results support and extend the safety analyses, which were the principal output of the study effort. Gross configuration concepts and layouts for the Phase B Future Space Station and Space Base are shown. A brief analysis of Space Station and Space Base operations is presented for the on-orbit phases of the operation, including the relationship of the logistics support vehicles to the station and base. The experiment package was reviewed and hazards inherent to these experiments are identified. Crew distribution at typical times was determined and crew traffic patterns in the event of an emergency are shown. Problems of station contamination, together with possible or probable contaminants, are discussed. Medical requirements of the space station are reviewed briefly. The hazards and probabilities of meteoroid penetrations are discussed. Author

N70-20810*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: LOGIC DIAGRAM
Jan. 1970 182 p refs
(Contract NAS9-9046)
(NASA-CR-108291; D2-113070-9) Avail: CFSTI CSCL 22B

The logic diagram in this document explicates a heuristic analysis directed at discovering what is required for the crew of an Earth orbital manned space system to be safe. With the aid of the definitions of a few symbols, the complete diagram or any increment of it can be read as English prose. It was developed primarily to locate essential elements of hardware function and crew activity but may also be used to infer the probability of (or degree of belief in) crew safety, or be used as a basic management plan for task and responsibility assignment. Author

N70-20811*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: FAULT TREE ANALYSIS
Jan. 1970 73 p refs
(Contract NAS9-9046)
(NASA-CR-108289; MSC-00189; D2-113070-10) Avail: CFSTI CSCL 22B

A number of functions in an Earth-orbiting space station concept were investigated for safety implications by the fault tree analysis technique. Certain major undesired events, selected from a logic analysis of the space system concept were subjected to the fault tree analysis to identify safety guidelines at a level of detail commensurate with study objectives. These analyses provide a rationally developed and orderly foundation for generating the safety guidelines, and display the relationships of potential undesired events to the basic functions that are characteristic of space system operations. This document contains a description of the fault tree technique, a complete file of the trees which were developed during the course of the Safety Study, and an index to the guidelines which were derived from the analysis. Author

N70-20812*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY: SUBSYSTEM ANALYSIS
Jan. 1970 88 p refs
(Contract NAS9-9046)
(NASA-CR-108287; D2-113070-11) Avail: CFSTI CSCL 22B

An analysis of generic subsystems that must be included in a spacecraft for a long-duration, manned, Earth-orbital mission was performed to identify potential hazards to crew safety, and the possible causes and effects of these hazards. The causes and effects were analyzed to determine appropriate safeguards which would prevent or contain the potential hazards identified. Safety guidelines were written which encompassed all of the recommended safeguards. Author

N70-21012*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TECHNICAL INFORMATION SUMMARY: APOLLO 11 (AS-506); APOLLO SATURN 5 SPACE VEHICLE
25 Jun. 1969 69 p
(NASA-TM-X-62812; S/E-ASTR-S-101-69) Avail: CFSTI CSCL 22B

A brief and concise description of the AS-506 mission and the Apollo Saturn space vehicle is presented. The space vehicle, its systems and subsystems are not completely defined; by text and sketches, the launch preparation, ground support equipment and activities, and the space vehicle are described. AS-506, Apollo 11, Mission G-1, is the first Lunar Landing Mission. Its purpose is: (1)to perform a successful lunar landing, (2) assess the capabilities and limitations of the astronauts and their equipment in a lunar surface environment; (3) perform inspection of the lunar surface and obtain soil samples, and (4) to safely return the crew to earth. The launch vehicle objectives are to demonstrate capability to inject the spacecraft onto a free-return, translunar trajectory. The AS-506 mission profile consists of launch and boost to earth parking orbit, coast in earth parking orbit, translunar injection, translunar coast, S-4B slingshot, lunar orbit insertion, lunar module descent, lunar surface activities, lunar module ascent, transearth injection, transearth coast, reentry, splashdown and recovery. Author

N70-21091*# Booz-Allen Applied Research, Inc., Bethesda, Md.
ECONOMIC VIABILITY OF A SATELLITE SURVEYING SYSTEM Final Report
William E. Brockman 29 Dec. 1969 73 p refs
(Contract NASw-1674)
(NASA-CR-109080; Rept-9019-030-9) Avail: CFSTI CSCL 22B

NASA is constantly reassessing areas of space technology regarding their potential capabilities for conversion into a public or commercial operational system. The present study had the purpose of determining whether an operational system based on NAVAID geodetic satellite technology could compete successfully in the commercial land surveying market. Such a satellite system can be visualized as having three subsystems: first, the orbiting satellites that will produce a signal for the ground stations to receive; second, the ground station tracking network -- the permanent network that will determine the orbital position and orbital information of the satellite; and third, the portable instruments used by the ground surveyors to determine the geodetic positions on the ground using the satellites as the reference points. The recognized method for a commercial enterprise to assess the economic feasibility of a new product is to determine the existence and size of the market for the product. The present study determined what product could be sold to what group of potential users for what price and estimated the gross revenue to an enterprise operating the system. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-19719*# TRW Equipment Labs., Cleveland, Ohio. Materials Technology.
NONDESTRUCTIVE FLAW DEFINITION TECHNIQUES FOR CRITICAL DEFECT DETERMINATION Final Report, 1 May 1968-30 Sep. 1969
Frank J. Sattler Jan. 1970 152 p refs
(Contract NAS3-11221)
(NASA-CR-72602; TRW-ER-7419) Avail: CFSTI CSCL 20K

The accuracy of radiographic, penetrant, ultrasonic shear wave and ultrasonic delta inspection methods were evaluated on defect specimens made from 2014 and 2219 aluminum, and 5Al-2.5Sn and 6Al-4V titanium alloys. The accuracies of these test methods are compared for these alloys at nominal section thicknesses of 0.020, 0.125, 0.500 and 1.000-inches. The penetran test method provided the most accurate test to determine defect length in all but the 0.5 and 1.0-inch aluminum specimens. Radiographic inspections provided the best accuracy in the 0.5 and 1.0-inch aluminum specimens. None of the test methods had sufficient accuracy in determining critical crack depths as determined from fracture toughness calculations. The effects of stress conditions on the detectability of defect dimensions were evaluated. Fracture toughness calculations were made from the defect dimensions and tensile test data on the specimens. Author

N70-19724# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
DYNAMICS OF VERTICAL TUBULAR CANTILEVERS CONVEYING FLUID
M. P. Paidoussis Feb. 1969 85 p refs
(Rept-69-3) Avail: CFSTI

A general theory is presented to account for the small, free, lateral motions of a vertical, uniform, tubular cantilever conveying fluid, with the free end being either below the clamped one or above it. Gravity forces are not considered to be negligible. It is shown that, when the velocity of the fluid exceeds a certain value, the cantilever in all cases becomes subject to oscillatory instability. In the case of hanging cantilevers buckling instability does not occur. Standing cantilevers, on the othe hand, may buckle under their own weight. Extensive complex frequency calculations were conducted to illuminate the dynamical behaviour of the system with increasing flow. The conditions of stability have also been extensively calculated and stability maps constructed. It is shown that dissipative forces may have either a stabilizing or a destabilizing effect on the system, partly depending on the magnitude of these forces themselves. Experiments with hanging rubber tubes conveying either air or water, and with standing tubes conveying air, confirm all essential features of the theory. Quantitative agreement between theory and experiment is quite satisfactory. Author

N70-19746# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
FREE VIBRATION OF A HEAVY, DAMPED CANTILEVER IN A PLANE INCLINED TO THE VERTICAL
M. P. Paidoussis and P. E. des Trois Maisons Aug. 1969 29 p refs
(MERL-69-6) Avail: CFSTI

At the initial stages of this investigation it was discovered that the resonant frequencies of a vertical, heavy cantilever (such that gravity forces were not negligible) were not readily available. The method of determining the flexural rigidity and internal damping of the cantilevers involved resonant frequency measurement of the fundamental mode and the corresponding logarithmic decrement of the cantilever hanging vertically. Two models for energy dissipation in the material of the cantilever were used: in the one the process is considered to be hysteretic, and in the other a two parameter Kelvin-Voigt model is employed; in both cases damping is considered to be relatively small. The formulation was generalized to cover cantilevers whose position of rest and free motions are in a plane inclined to the vertical. Author

N70-19829# Aeronautical Research Labs., Melbourne (Australia).
COMMENTS ON FRACTURE MECHANICS
B. C. Hoskin Jun. 1969 10 p refs
(ARL-SM-340) Avail: CFSTI

A brief survey is given of the main theoretical developments in fracture mechanics, and some comments are made on applications of the subject to structural problems. Elasticity solutions for cracked structures, fracture of brittle materials, fracture of ductile materials, and fracture mechanics and fatigue are reviewed. Author

N70-19830*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research and Engineering Center.
SATURN 5 LAUNCHER-UMBILICAL TOWER VIBRATION ANALYSIS, VOLUME 2: A COMPUTER PROGRAM FOR ANALYSIS OF THE VIBRATIONAL CHARACTERISTICS OF LARGE LINEAR SPACE FRAMES Final Report
[1969] 70 p refs
(Contract NAS8-21301)
(NASA-CR-102465; LMSC/HREC-D148844-2) Avail: CFSTI CSCL 20K

The program provides an economical means of accurately computing the vibrational characteristics of complicated frame structures. The computational procedure used in the program deals exclusively with non-zero submatrices of the system mass and stiffness matrices. The solution technique is, in effect, a generalization of beam vibration analysis. The program is automatic in the sense that both input and output communications are concise. Input data consist of minimum definitions of particular problems, joint position coordinates, member properties, restraint conditions. Output data consists of optional solution information, including computer-generated plots of mode shapes. Several examples are presented of solutions computed by the program. A wide variety of member types is allowed, including open and nonsymmetrical sections. Frame members may be either uniform beams or Timoshenko beams with arbitrarily varying mass and stiffness properties. Provisions are also included for rigid links, lumped masses and other features useful in mathematically modeling complicated linear structures. For Vol. 1, see N70-10532. Author

N70-19832 Michigan State Univ., East Lansing.
APPLICATION OF A DISCRETE ELEMENT MODEL TO THE STUDY OF THE STATIC AND DYNAMIC STABILITY OF BARS, ARCHES, AND RINGS
Philip Clark Rymers (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-5939

A physical model of a structural component consisting of a series of mass points connected by bars is used to investigate stability of the structural component. The bars are incapable of bending but exhibit axial strain capability. Bending is accounted for by considering each mass point to be a nodal point and by attaching a torsion spring across the node. Equations of motion are written for each mass point. The problems investigated include: the buckling of a straight, pin-ended bar, including the effect of axial strain; the static buckling pressure on a circular ring, considering both normal and central loading; the buckling of a column, including the follower force type of loading; the determination of the period of oscillation of a beam; the determination of the period of oscillation of an inextensible circular arch; and the determination of the pure impulse required to cause snapbuckling of an arch. Dissert. Abstr.

N70-19850# Argonne National Lab., Ill.
DYNAMIC PLASTIC RESPONSE OF A TUBE TO AN IMPULSIVE RING LOAD OF ARBITRARY PULSE SHAPE
Carl K. Youngdahl Apr. 1969 58 p refs
(Contract W-31-109-eng-38)
(ANL-7562) Avail: CFSTI

The problem of the deformation of a long, circular, cylindrical shell made of a rigid, perfectly plastic material and subjected to an impulsive ring load is solved for arbitrary pulse shapes. The principal result of the investigation is that the dynamic effect of the pulse shape is almost completely characterized by its associated impulse and effective load (defined as the impulse divided by twice the mean time of the pulse). This means that details of the pulse shape and, in particular, its peak value are comparatively unimportant in determining the history of the plastic deformation and the final shape of the shell. The implications for experimental work are encouraging, since the impulse and effective load are easily computed from a pressure-time plot and are not strongly influenced by experimental inaccuracies. Author (NSA)

N70-19883# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
NEW CORRELATION OF THE EFFECTS OF HOLD TIME ON LOW-CYCLE FATIGUE BEHAVIOR
J. B. Conway, J. T. Berling, and R. H. Stentz Jun. 1969 61 p refs
(Contract AT(40-1)-2847)
(GEMP-702) Avail: CFSTI

Closed-loop, servo-controlled, hydraulic testing machines were employed in axial strain control to measure the effect of hold time on the low-cycle fatigue behavior of fully annealed 304 and 316 stainless steel at 650 C in an air environment. The strain-wave forms studied include one involving equal hold periods at both peak tensile and peak compressive strains; another involving a hold period at peak tensile strain only; while the third was concerned with a hold period at the point of peak compressive strain. Tests were performed at constant strain rates (excluding the hold period itself) of over strain ranges to 2%. It was found that the hold period in tension only was particularly detrimental and led to drastic decreases in the cyclic fatigue life. Fatigue results obtained in the

N70-19958# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
HARMONIC NON-AXISYMMETRIC WAVES WITH SHORT WAVE LENGTHS PROPAGATING IN COMPOSITE RODS
Anthony E. Armenakas and Henry E. Keck Aug. 1969 37 p refs
(Contract Nonr-839(40) FBM)
(AD-697999; PIBAL-69-34) Avail: CFSTI CSCL 20/11

The asymptotic phase velocities at very large wave numbers of non-axisymmetric waves, traveling in composite rods are established analytically. Frequency spectra and mode shapes of composite rods are presented and compared with those of simple (made of one material) rods. Author (TAB)

symmetrical-hold tests and in the compression-hold-only tests were found to be in good agreement with tests involving no hold periods when the fatigue behavior was compared on the basis of plastic strain range. Author (NSA)

N70-20072 Duke Univ., Durham, N.C.
A FINITE ELEMENT APPROACH TO PLATE BENDING PROBLEMS
Leonardo V. Cruz (Ph.D. Thesis) 1968 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-3835

A new finite element has been derived for the analysis of orthotropic, variable thickness plates by the discrete or finite element method. The plate is idealized as an analog model constructed of these one dimensional elements and solved by the displacement method of structural matrix analysis. The discrete element, which is a generalization of Hrennikoff's framework molecule, is developed from the small deflection theory of thin plates. Effects such as orthotropy, variations in material properties and geometry, and temperature changes are readily taken into account; the method can handle arbitrary loading and boundary conditions, including cutouts. Numerical examples are presented to illustrate the underlying concepts and to evaluate the accuracy of the proposed element. Comparison of results with known solutions indicates good accuracy. The extension of the analysis to reinforced concrete slabs is discussed and two examples presented. The computational procedure is programmed in FORTRAN IV for an IBM/S360 computer. Dissert. Abstr.

N70-20141 Stanford Univ., Calif.
ON THE PROBLEM OF GEOMETRICAL IMPERFECTIONS IN THIN CIRCULAR CYLINDRICAL SHELLS
Donald Reed Shover (Ph.D. Thesis) 1968 179 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8268

The stability of the thin circular cylindrical shell loaded in axial compression has been studied. The first technique utilized a device that was designed and fabricated to measure the thickness of thin cylinders at a large number of locations employing the method of pneumatic metrology. Data obtained from a representative cylinder are discussed and shown on a contour map. A maximum variation in wall thickness of about 13 per cent was measured. Two separate experimental techniques were developed to measure the deviation of the cylinder from the perfect circular shape. In both systems, the measurements were taken by scanning the entire cylinder using either an optical or capacitance type device. Dissert. Abstr.

N70-20167 Alabama Univ., University.
A PHOTOELASTIC INVESTIGATION OF AN ORTHOTROPIC PLATE ON A SIMULATED SOIL FOUNDATION
Robert Oliver Case (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-6533

The purpose of this research was to perform a photoelastic stress analysis of an orthotropic plate subjected to a distributed load while resting on a simulated soil foundation. The photoelastic procedure consisted of (1) the determination of principal stress directions at selected points, (2) slicing of the model along one of these directions, and (3) analysis of each slice to determine the fringe order. Uniform pressure was assumed to exist under the applied load for the determination of external normal stress. External pressure on the model at the model-foundation interface was determined by means of measured deflections and a calibration curve for the foam foundation. Data were presented to illustrate principal stress magnitudes and directions. It was determined that peak stress values occurred on fillet boundaries of interior surfaces. Close agreement of a static equilibrium check of the simulated soil foundation with the applied load experimentally verified the procedure used for calculation of external pressure on the model-foundation interface. Dissert. Abstr.

N70-20183 Colorado Univ., Boulder.
SHOCK RESPONSE OF AN ELASTO-INELASTIC BEAM ON ELASTO-INELASTIC SUPPORTS
Bruce Emerson Burton (Ph.D. Thesis) 1968 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-4351

This thesis reports the investigation of the transient, dynamic response of an elasto-inelastic beam simply supported at each end on elasto-inelastic supports which are subjected to a half-sine ground acceleration pulse. The beam and supports have, respectively, bilinear, hysteretic moment-curvature and bilinear, hysteretic force-displacement characteristics. Since the beam-support system and the ground excitation are mutually symmetrical, the system response is also symmetrical. The primary objective is to obtain the maximum relative displacement at the ends of the beam and the maximum relative displacement, maximum bending moment, and maximum absolute acceleration at the midspan for a wide range of values of the nonlinear system parameters. The secondary objectives include a quantitative comparison of two finite-difference methods for solving the system of nonlinear differential equations and a study of the computational difficulties in determining the acceleration response for the elasto-inelastic system. Dissert. Abstr.

N70-20186 Northwestern Univ., Evanston, Ill.
FINITE ELEMENT ANALYSIS OF ELASTIC PLASTIC PLANE STRESS PROBLEMS BASED UPON TRESCA YIELD CRITERION
Subhash C. Anand (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-6882

A finite element technique for the elastic-plastic analysis of two dimensional structures, under plane stress condition and subjected to monotonically increasing loads, is presented. The complete load-deformation history as well as the propagation of the yield zones in the structure up to plastic collapse are studied. The continuum is idealized as an assemblage of triangular elements interconnected at a finite number of nodal points. It is assumed that the displacements between the nodes vary linearly and the resulting stresses and strains in the individual elements are necessarily uniform. The material is assumed to be elastic-perfectly plastic and yielding is governed by Tresca yield condition. Plastic stress-strain relations for the sides and corners of tresca yield condition are derived in terms of the Cartesian components of the stresses and strains and the principal stress direction. Dissert. Abstr.

N70-20188 Massachusetts Univ., Amherst.
FLEXURAL BEHAVIOR OF A STRUCTURAL SANDWICH
Gopal Singh (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-5184

The principle objectives of this study are to locate analytically the neutral axes of a structural sandwich and to determine normal stresses, shear stresses, and deflection in vertical direction at any cross section of the sandwich. In order to accomplish this, the facings and the core are split apart and considered separately. Stress and strain diagrams of each of the three units are drawn and six equations of equilibrium are developed to match with the six unknowns encountered. The only significant function performed by the core is to transfer shear forces from one interface to the other. In order to obtain distribution of shear stresses, normal stresses and shear forces acting on a strip of length dx at a distance x from one end of a structural sandwich are considered. Equilibrium equations of the horizontal forces acting on the top and bottom

facings, and of the moments acting on top facing, core, and the bottom facing are related to yield the shear stresses at the interfaces and within the facings. Dissert. Abstr.

N70-20190 New York Univ., N.Y. School of Engineering and Science.
BARS OF NONPRISMATIC OPEN SECTION SUBJECTED TO ARBITRARY END LOADINGS
William Augustin Brown (Ph.D. Thesis) 1968 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-4556

A general theory is developed to determine the elastic behavior of bars of nonprismatic open section under arbitrary end loadings. The loadings can include axial forces, bending moments, and torsional moments. The cross section of the member can be of any shape and vary in any fashion along the length of the member. Equations are derived to relate the loadings to the resulting lateral deformations and angle of twist at any cross section of the member. A finite-difference method of solving these equations is presented. The method is programmed for an electronic digital computer in order to obtain numerical results. Illustrative examples are included which show how to use the theory and computational method to obtain the lateral deflections and angle of twist under several loadings as well as the stiffness and carry-over factors for a particular bar of nonprismatic open section. The method is also applied to a channel of constant cross section to show that it is consistent with existing theories for prismatic bars of open section. Dissert. Abstr.

N70-20285 Colorado Univ., Boulder.
STIFFNESS MATRICES FOR THE ANALYSIS OF PLATE BENDING WITH TRANSVERSE SHEAR DEFORMATION
Lowell Frederick Greimann (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-4300

The matrix displacement finite element approach to the bending of elastic plates is presented with the inclusion of transverse shear deformation. Plate finite element models are based on Mindlin's plate theory. Unlike the finite element method derived from Kirchoff plate bending theory in which only the deflection normal to the plane of the plate is needed to describe the plate displacement, this method employs a set of three displacement fields. In addition to the lateral deflection, the rotations of the plate normal about the x and y axes in the plane of the plate are included. Three finite element models are used to investigate simply-supported and fixed square plates. The importance of the transverse shear effect is studied for both static and free vibration problems. The results are presented in graphs and compared with some of the existing exact solutions. It is concluded that the finite element model is a practical means to include the transverse shear effect in plate bending. Dissert. Abstr.

N70-20300# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
DYNAMIC ASPECTS OF CRACK PROPAGATION
George C. Sih Sep. 1969 43 p refs
(Contract N00014-68-A-0514; Proj. THEMIS)
(AD-696983; TR-1) Avail: CFSTI CSCL 20/11

The rate at which elastic and kinetic energies are released by a uniformly moving crack can be calculated from a line integral derived from energy-balance consideration. With the aid of the equations of motion, the divergence of the integrand is shown to vanish for certain closed path and thus indicating that the path of integration can be deformed arbitrarily without affecting the value of this integral which applies to linear or nonlinear materials. In view of this path independent property, the rate of energy release per unit crack extension can be evaluated simply from a knowledge of the local dynamic stress and displacement fields. As in the static theory of fracture, the detailed structure of the dynamic crack tip stresses and displacements are expressed independently of the crack geometry and loading conditions. This permits a general definition of the dynamic energy rates as related to the stress-intensity factors for elastic materials. Author (TAB)

N70-20345 California Univ., Berkeley.
ON SUPERPOSED MOTION IN ELASTIC PLASTIC MEDIA
William John Shack (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-10381

General equations governing a small motion superposed on a finite deformation are derived for an elastic-plastic material whose behavior is described by the theory of Green and Naghdi. The development is limited to the case where the finite deformation produces a fully plastic state in the material. Thermodynamical effects are included, and results are presented for both compressible and incompressible materials. The theory is used to discuss the effect of a small twist on a fully plastic circular bar undergoing a uniform large extensional deformation. The deformation of the bar is assumed to be quasi-static and isothermal, and the material is assumed to be isotropic and incompressible. Dissert. Abstr.

N70-20373*# Pittsburgh Univ., Pa. Space Research Coordination Center.
BOUNDS FOR THE EIGENVALUES OF A SIMPLY-SUPPORTED RECTANGULAR PLATE UNDER A COMPRESSIVE STRESS VARYING LINEARLY IN THE DIRECTION OF LOADING
G. Fauconneau and R. D. Marangoni 26 Jan. 1970 198 p refs
(Grants NsG-416; NsG-634)
(NASA-CR-108895; SRCC-164) Avail: CFSTI CSCL 20K

The effects of constant edge loads and of a uniformly distributed in-plane load on the transverse vibrational frequencies and elastic stability characteristics of a simply-supported plate are investigated. Bounds for the eigenvalues are obtained for various plate width-to-length ratios as functions of two parameters associated with the distributed in-plane load and the edge loads. The upper bounds are calculated by the Rayleigh-Ritz method and the lower bounds by the second projection method of Bazley and Fox. In all instances, the gap between the bounds over their average is less than are half of one per cent. Buckling load combinations are obtained by determining the values of the loading parameter making the first eigenvalue equal to zero. Author

N70-20390# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
PROPAGATION OF HARMONIC WAVES IN COMPOSITE CIRCULAR CYLINDRICAL SHELLS. PART 2: NUMERICAL ANALYSIS
Anthony E. Armenakas Oct. 1969 55 p refs
(Contract Nonr-839(40))
(AD-698179; PIBAL-69-44) Avail: CFSTI CSCL 20/11

The frequency equation for harmonic waves with an arbitrary number of circumferential nodes traveling in composite traction-free circular cylindrical shells established in the first part of this investigation has been programmed for numerical evaluation on an IBM 7094 digital computer. The numerical results obtained are employed in evaluating the effect of the changes of the shell parameters on the frequency and shape of the first few modes of wave propagation. Moreover, the asymptotic limits of the phase velocities for waves having short axial wavelengths are established analytically and verified by the numerical results. Author (TAB)

N70-20395 Pennsylvania State Univ., University Park.
A STUDY OF THE FACTORS INFLUENCING STRESS DISTRIBUTION, FRACTURE INITIATION AND FRACTURE PROPAGATION IN LINE AND WEDGE-LOADED RECTANGULAR PLATES

Joseph Charles Conway (Ph.D. Thesis) 1968 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-9748

The mechanisms of fracture initiation and propagation in finite plates subjected to rapidly applied edge line loads directed along the vertical plate axis are dealt with. All other points on the top and sides of the plate are traction free, and the bottom is assumed to rest on a flat, high-modulus surface so that minimal friction exists between the plate edge and surface. Both a mathematical and experimental approach were utilized. The mathematical solution was used to generate the stress distributions in line-loaded plates of various depth/half-width ratios, and the influence of these ratios on the distributions was noted. The theoretical isochromatics and isoclinics were then generated for the square plate and checked photoelastically. Finally, the mathematical solution was used to predict the line load at fracture initiation in a square plate assuming the octahedral shear theory of failure and the mechanical properties of Columbia Resin-39. Dissert. Abstr.

N70-20507*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPRESSIVE INSTABILITY AND STRENGTH OF UNIAXIAL FILAMENT-REINFORCED EPOXY TUBES
John G. Davis, Jr. Washington Mar. 1970 46 p refs
(NASA-TN-D-5697; L-6905) Avail: CFSTI CSCL 20K

The results of an investigation on the column buckling, local buckling, and crushing strengths of more than 100 uniaxial filament-reinforced epoxy tubes are presented. Two types of materials, S-glass-epoxy and boron-epoxy, were utilized in the investigation. All tubes had a nominal diameter of 0.5 inch (1.3 cm); whereas specimen length ranged from 1 to 40 inches (3 to 100 cm) and wall thickness from 0.015 to 0.098 inch (0.38 to 2.48 mm). Column-buckling and local-buckling strengths were compared with theory. The effect of shear deflections in a buckled column had to be considered in order to predict accurately column-buckling strengths for both types of tubing. In addition, use of a value for shear modulus approximately equal to one-half the shear modulus of the respective materials gave good correlation with experimentally determined column-buckling and local-buckling strengths for both types of tubing. Further research is required to explain the necessity of using a reduced value of shear modulus in analyzing the behavior of the test specimens. Based on data obtained in the study, the application of boron-epoxy to tubular compression members can result in nearly a 50-percent reduction in weight as compared with the utilization of aluminum. Author

N70-20571*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SURFACE PROTUBERANCES ON IMPACT LIMITERS FOR SPHERICAL HARD-LANDING PAYLOADS
John Locke Mc Carty and James T. Howlett Washington Mar. 1970 46 p refs
(NASA-TN-D-5698; L-6886) Avail: CFSTI CSCL 20K

An analytical and experimental study was conducted to evaluate the effect of surface protuberances, such as rocks, on impact limiters for spherical hard-landing payloads. The analytical phase of the study consisted of the extension of an existing analysis to include protuberances and the application of this extended analysis to establish the effect of protuberances on impact-limiter design. The experimental phase of the study was undertaken to validate the analysis and consisted of impacting a realistic and full-scale (for a prospective Mars mission) hard-lander configuration, equipped with balsa as an impact limiter, onto a rigid planar surface having conical or cylindrical protuberances. The experimental results validate the capability of the extended analysis to design the impact limiter by predicting the effect of surface protuberances on limiter response. Author

N70-20580*# TRW Systems Group, Redondo Beach, Calif.
INVESTIGATION OF HYPERVELOCITY MICROPARTICLES IMPACT PHENOMENA
J. C. Slattery and N. L. Roy 6 Mar. 1970 52 p refs
(Contract NAS1-8299)
(NASA-CR-66872; TRW-11489-6012-R0-00) Avail: CFSTI CSCL 20K

Experimental results obtained during the past year with a micrometeoroid linear accelerator are presented. The linear accelerator accelerates metallic, microsize particles to velocities up to 25 km/sec. Five experiments are included: (1) impact light flash; (2) thin film capacitors; (3) microphone sensors; (4) cratering; (5) thin film penetration. Results are presented on the response of capacitor microphones to hypervelocity impact at velocities much higher than were previously possible. Much of the work on thin film penetration was possible because relatively thick foils could be used at the higher velocities attainable with the linac; uniformly thick foils are easier to make than uniformly thin ones. Author

N70-20677*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
PROPELLANT SLOSH COUPLING WITH BENDING Interim Report
G. C. Feng and M. L. Pearson Jun. 1969 146 p refs
(Contract NAS8-21485)
(NASA-CR-108972; HREC-1485-1; LMSC/HREC-D148988) Avail: CFSTI CSCL 20K

In this study, a program called SLOSH was developed. This program computes the mass and stiffness matrices of the system associated with the liquid propellant and provides the lateral force distribution coefficients due to the dynamics of the propellant. A Lockheed/Huntsville-developed bending program was modified to a two-dimensional case in order to accomodate the additional slosh modes used in the present model. This program computes the mass and stiffness matrices of the system associated with the hardware of a vehicle. After a combination of the two sets of matrices, the bending program will solve the constructed eigenvalue problem. A study of the vibrational characteristics of Saturn V during its first-stage flight is included as an example of the new method. Auser's guide of the developed digital SLOSH program is also provided. Author

N70-20690*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESIDUAL TENSILE STRENGTH IN THE PRESENCE OF THROUGH CRACKS OR SURFACE CRACKS
Paul Kuhn Washington Mar. 1970 41 p refs
(NASA-TN-D-5432; L-6658) Avail: CFSTI CSCL 20K

A method of crack-strength analysis for through cracks previously published is briefly restated and discussed. A formula is then given which, in effect, converts a surface crack into an equivalent through crack so that strength calculations can be made. Twenty-five sets of tests on surface cracks are shown together with predicted curves based on through-crack tests. The predicted strengths are either reasonably close or somewhat conservative. Author

N70-20715# Blum (John A.) and Associates Research Div., San Francisco, Calif.
STRUCTURAL RESPONSE: STERLING EVENT
Jul. 1969 19 p refs
(Contract AT(26-1)-99)
(NUF-1044) Avail: CFSTI

Sterling event was detonated on December 3, 1968, at 0615 hours CST and involved a 350-ton nuclear device in a decoupled emplacement in Lamar County, near Baxterville, Mississippi. The device was emplaced in the center of 110-foot nominal diameter cavity in the Tatum Salt Dome about 2,700 feet below the earth's surface. The cavity had been created by the SALMON explosion on October 22, 1964. Calculations by others.

prior to the Sterling Event, indicated that event-caused ground motion would be negligible. Therefore, no structures were instrumented for this event. However, nineteen structures in cities and towns surrounding the test site were selected for observation. Residences were chosen for close-in structure monitoring because of the lack of other building types; commercial or institutional structures were selected for the outlying cities and towns. Detailed condition surveys were made on all selected structures, and all information gathered, including photographs, was compiled into a field report that was utilized by observers during the pre-shot, shot-time, and post-shot surveys. Author (NSA)

N70-20749# Brown Univ., Providence, R.I.
A NEW DESTABLIZATION PHENOMENON IN NONCONSERVATIVE SYSTEMS
R. H. Plant 1969 12 p refs
(Contract N00014-67-A-0191-0009)
(AD-697665) Avail: CFSTI CSCL 20/11

A new destabilization phenomenon for nonconservative systems is demonstrated. It is shown that a double pendulum subjected to a follower load may become unstable when the damping in the system is increased in value. This unexpected effect is caused by interaction of internal and external damping mechanisms. Author (TAB)

N70-20787 British Ship Research Association, Wallsend (England).
PARTICULARS OF THE OPERATION OF SHAFTING ABOARD REINFORCED PLASTICS CRAFT
V. V. Alekseev et al 1969 9 p refs Transl. into ENGLISH from Sudostroenie (USSR), No. 3, 1969 p 28-31
(BSRA-Trans-3158) Avail: BSRA Wallsend, Northumberland, Engl.: £5

A method of investigation and the results of measurement of bending stresses and torsional vibrations in two different types of flexible link of the shafting applied to a plastics craft are outlined. The findings confirm the need for a flexible link in the connection of the shafting with the engine, and provide the best design criterion for a flexible link of the shafting-cardan or torsional shaft. Test results show that in both shaft lines, mainly vibrations of the three node form develop. Other tests demonstrate that for a plastics craft in sea state 5, the bending stresses in the shafting rise 15 to 45%. Of the two designs studied for a flexible link, the better one is the torsional shaft, the torsional pliancy of which must be selected according to the most favorable development of torsional oscillations in the shafting. Author

N70-20798# Iowa Univ., Iowa City.
LONGITUDINAL WAVE PROPAGATION ON A TRAVELING THREADLINE 2
W. F. Ames, S. Y. Lee, and A. A. Vicario, Jr. Mar. 1969 30 p refs
(Contract DAAF03-69-C-0014)
(AD-697741; THEMIS-UI-7) Avail: CFSTI CSCL 13/9

This paper investigates axial wave propagation in a moving threadline. In particular, a more general formulation is introduced wherein the stretch (extension ratio) is employed together with a nonlinear constitutive law. Some specific examples are detailed, the shock problem is considered and the evolution of discontinuities from smooth initial data is examined. Author (TAB)

N70-20820*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.
NONLINEAR DAMPING IN STRUCTURES
C. S. Chang Sep. 1969 77 p refs
(Contract NAS8-21435)
(NASA-CR-102503; HREC-1435-1; LMSC/HREC-D149171) Avail: CFSTI CSCL 20K

An analytical and experimental study of the dynamic responses of a structure with nonlinear and nonproportional damping is presented. The analysis shows that the steady-state solution of a structure with damping at its boundary can be obtained from the undamped vibration solutions, and that if nonproportional damping is low, classical normal mode responses are indicated by the derived general solution. The analytical results are used to develop experimental approaches to determine damping properties of substructures or structural elements. Experimental studies are used to demonstrate the developed techniques. Author

N70-20830# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
SANDERS TYPE IMPROVED SHELL THEORY FOR GENERAL ORTHOGONAL COORDINATES
James Sheng Oct. 1969 30 p refs
(Contract DAHC04-69-C-0016)
(AD-697818; THEMIS-AE-69-6; AROD-T-4.11-E) Avail: CFSTI CSCL 21/5

To predict and to prevent structural failures in the compressor blades and turbine buckets of jet engines, analytical investigation of their natural frequencies as well as transient stresses and deformations is imperative. As higher performance of the engine is demanded, the blade section becomes more and more a piece of thin shell mostly in the form of an airfoil and its attachment is flexible. The purpose of the report is to build up a solid foundation upon which the problems of thin shells can be based when the lines-of-curvature coordinates should be avoided. In this report mathematical derivations are worked out. The three final equilibrium equations for any arbitrary orthogonal curvilinear coordinate system and the boundary conditions are fully presented. TAB

N70-20832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS (SELECTED ARTICLES)
G. N. Savin et al 24 Feb. 1969 34 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 3, no. 9, 1967 16 p
(AD-686906; FTD-HT-23-1074-68) Avail: CFSTI CSCL 20/11

Contents: Growth of cracks during destruction of solid polymers; Limit deformativity of anisotropic plastics under biaxial compression; Experimental investigation of deformation of constructions by means of curvature gauges with pneumatic contacts. TAB

N70-20861*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE MECHANICS CONCEPTS APPLIED TO AEROSPACE STRUCTURAL PROBLEMS
John L. Shannon Jr. and William F. Brown, Jr. *In its* Aerospace Structural Mater. 1970 p 1-17 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 20K

Our research has been directed at two closely related problems: (1) the development of test methods for the qualitative evaluation of brittle crack propagation resistance (fracture toughness) that would be useful as a screening tool in alloy development, and (2) the development of a quantitative measure of fracture toughness which would be useful in design and proof testing. Specimens containing cracks or very sharp notches to simulate cracks have been developed as a screening tool in evaluating relative fracture toughness. The influence of many factors on the crack toughness of alloys suitable for aerospace applications has been studied using these specimens. These factors include heat treatment, thermomechanical working, service environment, alloy purity, and certain geometrical variables. Author

N70-20862*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPROACHES TO LIFE-PREDICTION PROBLEMS IN CREEP RUPTURE AND FATIGUE AT HIGH TEMPERATURES
S. S. Manson *In its* Aerospace Structural Mater. 1970 p 19-42 refs (See N70-20860 08-17)
Avail: CFSTI CSCL 20K

Life prediction procedures are discussed for two types of design problems encountered in high-temperature approaches such as in the jet propulsion engine and in nuclear power generation equipment. The first prediction method relates to the estimation of life of components that must endure for longer periods than can reasonably be duplicated in real time in the laboratory. The approach relies on a generalization of the concept of time-temperature parameters in which higher temperature is substituted for longer time in generating the data from which the extrapolations are made. The method applies an optimization procedure for seeking out the most pertinent parameter whether or not it is among those in common use. The second prediction method relates to the estimation of fatigue life at high temperature, wherein the complexity of loading and the wide range of service conditions makes impractical the direct simulation of service in preliminary laboratory tests. Author

N70-20947# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE DETERMINATION OF TEMPERATURE STRESSES IN SEAMLESS FORGED ROTORS

V. A. Ablamskii et al 17 Mar. refs Transl. into ENGLISH from Naukova Dumka (Kiev), 1967 p 502-508

(AD-697602; FTD-HT-23-1136-68) Avail: CFSTI CSCL 13/9

The approximate rating of temperature stresses in seamless forged rotors is discussed on the basis of simplified methods, introducing a correction factor and an activity factor. The correction factor is determined from correlations of the experimental and calculated stresses, and the activity factor is determined from the condition of minimum potential energy deforming the rotor through temperature stresses. The temperature stresses were determined for a drum and a disk rotor made of stainless steel by solving the heat conductivity functions numerically and by modeling. The obtained data show a relatively uniform stress distribution character along the drum rotor and nonuniformly distributed stresses along the disk rotor. The approximately determined temperature stresses of the drum and disk rotors agree with data obtained by more precise calculations of finite length cylinders, and the stress levels provide the required safety. Author (TAB)

N70-20851# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.

ON WAVE PROPAGATION IN ONE DIMENSIONAL RUBBERLIKE MATERIALS

W. F. Ames Oct. 1969 15 p refs

(Contract DAAF03-69-C-0014; Proj. THEMIS)

(AD-698016; THEMIS-UI-14) Avail: CFSTI CSCL 20/11

An investigation was made of the propagation of mechanical waves in straight bars or wires, or rubber-like materials, having negligible transverse dimensions and possessing a uniform cross section of finite area. The times to discontinuity evolution from smooth initial data are computed and used to ascertain the region of validity of the generalized Lagrange series solution. TAB

N70-21078# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

STUDY OF THE APPLICATIONS OF FIBROUS COMPOSITES TO DEEP SUBMERGENCE SHELL STRUCTURES

R. W. Snyder, N. F. Dow, and B. W. Rosen Aug. 1969 82 p refs

(Contract N00014-66-C-0167)

(AD-697690; DOC-69SD10) Avail: CFSTI CSCL 13/10

Small deflection buckling theory is applied to the efficiency study of laminated cylindrical shells subjected to external pressure. Limitations of a theory which neglects material coupling terms is determined. Guidelines are established for the efficient design of cylindrical shells. Author (TAB)

N70-21098 National Lending Library for Science and Technology, Boston Spa (England).

BANDS OF SLIP UNDER TENSION IN THIN PLATES WITH RECTILINEAR SLITS [POLOSY SKOLZHENIYA PRI RASTYAZHENII TONKIKH PLASTIN S PRYAMOLINEINYMI RAZREZAMI]

P. M. Vitvitskii Nov. 1969 9 p refs Transl. into ENGLISH from Kontsentratsiya Napryazh. (Kiev), v. 1, 1965 p 78-85

(NLL-RTS-5454) Avail: Natl. Lending Library, Boston Spa, Engl.: 20s or 3 NLL photocopy coupons

The development of plastic deformation and of slip bands at the ends of two equal rectilinear slits in a plate of infinite length is analyzed. Assumed is that these deformations are concentrated along certain lines and that certain discontinuities and displacements along the lines are present. Developed is a scheme of plastic flow where the continuity of the material is maintained; disturbance of the material compatibility is excluded owing to the localized thinning, or thickening of the plate. Thus, the localized character of the slip band development means that the elastic-plastic equilibrium problem of the plate is reduced to the problem of equilibrium of an elastic plate, the displacements of which along definite lines are subjected to discontinuities. G.G.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-19708# United Kingdom Atomic Energy Authority, Harwell (England).

SOME ASPECTS OF HEAT TRANSFER IN A GAS FLUIDISED BED

G. A. Henwood Jul. 1969 25 p refs

(AERE-R-6027) Avail: CFSTI

The wall bed local heat transfer coefficients within a fluidized gas/solid system were determined in a two-dimensional bed using specially designed heat transfer probes. In a series of interrelated experiments the effects on the heat transfer coefficient of the superficial gas velocity, the properties of the solid material and of the fluidizing gas, together with the particle size, were determined. The results are presented as a series of graphs and they are interpreted in terms of a previously published theory. A further series of experiments explored the variation of the local heat transfer coefficient in the vicinity of a large single bubble. It was found that these results provide a qualitatively satisfactory explanation of the overall effect on the heat transfer coefficient when the superficial velocity of the fluidizing gas is varied. Author (NSA)

N70-19706# National Engineering Lab., Glasgow (Scotland). Applied Heat Transfer Div.

PRESSURE DROP AND HEAT TRANSFER ON THE SHELL SIDE OF A MODEL HEAT EXCHANGER WITH TWO-PHASE FLOW

L. A. Sutherland and I. Murray Mar. 1969 32 p refs

(NEL-395) Copyright. Avail: CFSTI

The flow of an air-water mixture through the shell-side of a model of a heat exchanger is examined experimentally and correlations for data on isothermal pressure-drop have been developed. Local measurements of heat-transfer coefficient have been made. Air-water mixtures with qualities up to 10 per cent of air were used with pressure and temperatures close to atmospheric. Author

N70-19716# Technische Hogeschool, Eindhoven (Netherlands). Lab. for Heat Transfer and Reactor Engineering.
SOME HYDRODYNAMIC ASPECTS OF A BOILING WATER CHANNEL
F. J. M. Dijkman 30 Dec. 1969 177 p refs
Avail: CFSTI

The influence of subcooling, of a sine-shaped heatflux, and of a combination of both on the steady state and dynamic characteristics of natural-circulation, pressurized, boiling water system, were studied. In natural-circulation boiling systems hydrodynamic instabilities may occur at constant power. They appear to arise from a dependence of the vapor volume production rate upon the flow rate as a result of energy conservation and simultaneously the flow rate depends upon the resident vapor volume in the system as a result of momentum conservation and continuity. The steam pressures were taken 15.5 and 30 atm, corresponding to saturation temperatures of 200 C and 234 C respectively. Although the experimental results disclose the fact that the transition from stable to unstable behavior is not accompanied by a discontinuous change of all physical variables, preference has been given to a classification of the experiments in steady state and dynamic measurements.
Author

N70-19718# Los Alamos Scientific Lab., N.Mex.
PHASE FORMATION ACCOMPANYING THE INTERACTION OF TRANSITION METALS WITH CARBON IN THIN LAYERS
A. A. Babad-Zakhryapin et al [1969] 7 p refs Transl. into ENGLISH from Russian Conf. Paper on Thermodyn. of Nucl Mater. with Emphasis on Solution Systems, STI/PUB-162, Vienna, 1968 p 427-434
(LA-4213-TR; CONF-670915-10) Avail: CFSTI

A phase formation accompanying the interaction of transition metals with carbon in fine (20-50 micrometer) layers obtained by the condensation in vacuo of niobium, zirconium, tantalum, hafnium, and titanium vapors on the surface of graphite at 1500 to 2200 C is examined. The diffusion processes in such layers possess a number of specific features which can be used for growing compounds with a narrow homogeneity region. The various phases follow a certain sequence, depending on base layer temperature supersaturation of the metal vapors and the time of layer formation. The occurrence of one or another phase in the layers is found to bear a definite relationship to the manner of obtaining the layers. Under certain conditions all the carbide phases indicated in this table for each system are observed simultaneously within the layers, and the corresponding metal is observed on the outer surface of the layer. Compounds of the type MeCx are isomorphous with, and have a smaller lattice parameter than, known MeC carbides.
Author (NSA)

N70-19743# United Kingdom Atomic Energy Authority, Harwell (England).
DETERMINATION OF RATE OF DEPOSITION OF DROPLETS IN A HEATED TUBE WITH STEAM-WATER FLOW AT 1000 PSIA
G. F. Hewitt, H. A. Kearsey, and R. K. F. Keeys Jun. 1969 13 p refs
(AERE-R-6118) Avail: CFSTI

At the burnout or dryout point in heat transfer to two-phase annular flow a mass balance in an element terminating at the burnout point showed that the supply of liquid into this element consisted of two parts: supply along the surface in the form of a film and supply normal to the surface in the form of droplet mass transfer. The magnitude of the latter component was determined for steam-water flow at 1000 psia in a 0.497 in. bore tube by dryout heat flux measurements. By arranging for simultaneous dryout at the end of a heated length of the tube with high heat flux and a further short length of tube with a lower heat flux, it was possible to deduce the magnitude of the droplet deposition. Results were obtained for droplet deposition rate as a function of quality and mass velocity. The contribution of deposition represented a substantial fraction of the burnout flux over the whole range studied. Deposition rate cannot be regarded as being a unique function of local quality.
Author (NSA)

N70-19752*# Atlantic Research Corp., Alexandria, Va.
INVESTIGATION OF FLAME FRONT PHENOMENA: EFFECTS OF IMPRESSED ACOUSTICAL FIELDS Final Report
Robert L. Durfee and Jack M. Spurlock 6 Jun. 1969 110 p refs
(Contract NASw-1775)
(NASA-CR-108246; ARC-43-5440) Avail: CFSTI CSCL 20M

Phenomenology associated with effects of impressed acoustical fields upon flame propagation rates was studied with propane-air mixtures in open-ended tubes of 1.95 inches inside diameter. The sound source was a heating element located within the tube which established an acoustical resonance with the air column in the tube (singing tube phenomenon). Observed peaking of flame velocities was attributed to the presence of pressure loops associated with acoustical standing waves arising from the flame front itself and from the induced resonance. Local increases (peaks) in flame velocity of a factor of two or three above baseline values were observed under the influence of the singing, and these peaks corresponded to a narrow range of heater wattage. Under these conditions it is believed that reinforcement of the standing waves arising from the two acoustical sources occurred. These findings were used to correlate flame velocity data obtained with various tube geometries by other investigators.
Author

N70-19753# National Bureau of Standards, Washington, D.C. Building Research Div.
ALGORITHMS FOR PSYCHOMETRIC CALCULATIONS (SKELETON TABLES FOR THERMODYNAMIC PROPERTIES OF MOIST AIR)
T. Kusuda Jan. 1970 54 p refs *Its* Bldg. Sci. Ser. No. 21
Avail: SOD $0.55 Catalog No. C 13.29/2:21

Computer algorithms are presented for obtaining the thermodynamic properties of saturated and unsaturated moist air. The saturated moist air properties are calculated by a previously developed methodology. Sample calculations are performed using a computer program based upon the algorithms presented and the results are given.
Author

N70-19759# United Kingdom Atomic Energy Authority, Harwell (England).
BIBLIOGRAPHY OF REPORTS ON TWO-PHASE HEAT TRANSFER ISSUED BY AERE, HARWELL
L. B. Cousins Jun. 1969 24 p refs
(AERE-BIB-150) Avail: CFSTI

The reports and publications issued by the Two-Phase Heat Transfer Section of the Chemical Engineering Division are listed and summarized. The reports are divided into: burnout and heat transfer studies; and hydrodynamic studies on air-water systems. A list of other relevant reports is given in the supplement.
Author (NSA)

N70-19815# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.
EFFECT OF THE NONUNIFORM DISTRIBUTION OF HEAT FLOW ALONG A TUBE ON THE HEAT TRANSFER CRISIS [O VLIYANII NERAVNOMERNOGO RASPREDELENIYA TEPLOVOGO POTOKA PO DLINE TRUBY NA KRIZIS TEPLOOTDACHI]
B. A. Zenkevich, Yu A. Kalinin, O. V. Remizov, and V. I. Subbotin 1969 64 p refs In RUSSIAN
(FEI-150) Avail: CFSTI

The effects of a nonuniform distribution of heat flow along a tube on the heat transfer crisis were investigated for pressures of 686.7 to 1765 n/sq cm, mass velocities of (3.6 to 10)10 to

the 6th power kg/sq m. hr for tube lengths up to 1.2 m. It was found that for a certain combination of parameters the values of the total power and q sub cr may strongly depend on the law of heat release. Tables of the experimental data are given. Author (NSA)

N70-19842*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY INVESTIGATION OF ABLATIVE MATERIAL RESPONSE TO HIGH-INTENSITY CO2 LASER RADIATION
William D. Brewer Washington Jan. 1970 18 p refs
(NASA-TM-X-1941; L-6634) Avail: CFSTI CSCL 20M

Results are presented from an experimental study to obtain preliminary information about the performance of ablative materials subjected to very high radiative-heat fluxes. The radiative environment was produced by the 2-kW CO2 continuous-wave laser. Various ablative materials were tested in a controlled atmosphere at average radiative fluxes in the range from 30 to 45 MW/m squared. Graphite models were tested in air at pressures of 0.1, 0.3, and 1.0 atm and in nitrogen and helium at 0.1 and 0.3 atm. Carbon-phenolic, high and low density phenolic-nylon, a silicone elastomer, and a polybenzimidazole were tested in air at 0.1 and 0.3 atm and in nitrogen at 0.1 atm. Because the laser beam did not heat the surface of the models uniformly, most of the results are qualitative. Author

N70-20000 National Lending Library for Science and Technology, Boston Spa (England).
CONDENSATION OF STEAM ON THE SURFACE OF HORIZONTAL SCREW-PROFILED TUBES [KONDENSATSIYA VODYANYKH PAROV NA POVERKHNOSTI GORIZONTAL'NO RASPOLOZHENNYKH VINTOOBRAZNO PROFILIROVANNYKH TRUB]
A. P. Ozers Jan. 1970 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 4, 1967 p 71-74
(NLL-RTS-5344) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupons

Tests were conducted to determine the effects of screw-profiling of tubes on heat transfer when condensing saturated steam. Test equipment and procedures are described. Heat transfer coefficients were calculated in relative form and the effectiveness of profiled and smooth tubes were compared. Results show: (1) The heat transfer coefficient of screw-profiled tubes is not greatly affected by steam velocity at velocities up to 10 m/sec. (2) The heat transfer coefficient of screw-profiled tubes is 50 to 60% higher than that of smooth tubes. (3) Screw-profiled tubes should be tested under service conditions in steam-water heat transfer equipment. D.L.G.

N70-20056# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
BURNOUT HEAT FLUX MEASUREMENTS IN A LONG TUBE
F. R. Dell, G. F. Hewitt, R. K. F. Keeys, and R. Stinchcombe 1969 11 p refs
(AERE-M-2216) Avail: CFSTI

Burnout heat flux measurements are reported for upwards water flow in a 0.243 in. bore tube. Tube lengths of up to 217 inches were employed. Data were obtained for mass velocities of 1, 2, and 3 million lb/hr sq ft with an outlet pressure of 1000 psia. At high exit qualities the results show the expected change in form, indicating an entry into a different regime. Author (NSA)

N70-20084 Clemson Coll., S.C.
TRANSIENT, ONE-DIMENSIONAL HEAT TRANSFER FOR ALLOYS DURING SOLIDIFICATION
John Conrad Muehlbauer (Ph.D. Thesis) 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-5173

The transient one-dimensional solidification of a finite slab of length L is studied. The analysis is for a convectively cooled metal slab initially at a constant uniform temperature. The solidifying material is an alloy which freezes through a range of temperatures. During solidification part or all of the slab exists in a liquid state, a transition state, and/or a solid state. In the analysis the solidification process is divided into several time intervals. The dividing points between the time intervals are based on the occurrence of certain physical phenomena at the boundaries of the slab. Temperature profiles are determined for each region and each time period. Expressions for the positions of the boundaries of the change of phase regions, s and v, are also found. Dissert. Abstr.

N70-20108 National Lending Library for Science and Technology, Boston Spa (England).
TECHNICAL THERMODYNAMICS
M. P. Vukalovich et al Jan. 1970 8 p Transl. into ENGLISH from Tekhn. Termodinam. (USSR), sect. 7.5 p 141-144
(NLL-RTS-5466) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupons

Thermodynamic similarities are discussed for substances obeying the law of corresponding states and satisfying the same reduced equation of state. The reduced equation of state is applicable only to substances for which the van der Waals equation can be used. If two or more substances which satisfy the same reduced equation of state, have two of their parameters identical then the third relative property will also be the same -- the substances are in corresponding states. For thermodynamically similar substances, the reduced saturated vapor pressure and the reduced volumes of the saturated vapor and liquid in equilibrium, are related to the reduced temperature by expressions which are equal for all substances, i.e. which are universal functions of the reduced temperature. It also follows from the law of corresponding states that the specific heats, the heats of evaporation, the coefficients of surface tension and thermal conductivity of thermodynamically similar substances have common relations. E.M.C.

N70-20114 ITT Aerospace/Optical Div., Ft. Wayne, Ind.
RADIANT COOLER DESIGN AND EMISSIVITY STUDY. PART 2: EMISSIVITY STUDY Final Report, 8 Apr.-15 Dec. 1969
15 Dec. 1969 37 p refs
(Contract NAS5-11683)
(NASA-CR-108772) Avail: CFSTI CSCL 20M

The experimental determination of the hemispherical emissivity of surfaces suitable for use as the inner walls in a radiant cooler is covered. The experimental techniques is described, and the sources of error are analyzed. The technique permits the thermal-equilibrium determination of sample emissivities at temperatures in the range of radiant cooler cones (175K to 250K) and under thermal conditions similar to those in a radiant cooler. The results of the experiment show that the processes used to prepare cone walls are capable of producing a low-emissivity surface. The first sample studied had a hemispherical emissivity of 0.017 + or - 0.0015. The results also showed that the processes can produce an irregular surface of greatly increased emissivity. The second sample had an apparent surface emissivity which was about four times that of the first sample and a strong function of the emission angles covered. The design and thermal analysis of a radiant cooler for operation on board a Nimbus spacecraft are also covered. Author

N70-20132 California Univ., Berkeley.
THERMODYNAMICS OF HIGH-PRESSURE VAPOR-LIQUID EQUILIBRIA
Ping-Lin Chueh (Ph.D. Thesis) 1967 249 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 69-3731

The vapor phase fugacity coefficient is found from a revised Redlich-Kwong equation which contains corrections for the customary geometric-mean assumption. Liquid phase activity coefficients are normalized by the unsymmetric convention which uses Henry's constant as the standard-state fugacity for a supercritical component; as a result no arbitrary hypothetical liquid states are used. The composition dependence of the activity coefficient is given by the dilated van Laar model which takes into consideration the increase in the effective molar volume of each component as the liquid mixture approaches the critical state. This model contains two temperature-dependent constants per binary, and is readily generalized to the multicomponent case using binary constants only. The pressure dependence of the activity coefficient is given by the liquid phase partial molar volume. This quantity, which is the key to better representation of high pressure equilibria, is found from a liquid phase equation of state and from the corresponding-states correlation of saturated liquid volumes of Lyckman and eckert. The thermodynamic development is illustrated with calculations for binary systems containing paraffins, olefins, acetylene, nitrogen and carbon dioxide. Dissert. Abstr.

N70-20250 California Univ., Los Angeles.
THERMAL CONDUCTANCES AND PEAK HEAT CURRENTS OF IMMERSED GRAPHITE HEATERS IN LIQUID HELIUM 2
Rolla Craig Chapman (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-8093

Bulk solid to liquid helium thermal conductances and the peak heat currents of immersed graphite heater-thermometer specimens in liquid helium were measured with single element units and sandwich specimens. Thin graphite films deposited on Mylar substrates served as single element specimens to measure heat fluxes to a liquid helium 2 bath under D.C. and low frequency pulse conditions. The films employed in these measurements were used simultaneously as Joule heat sources and as temperature sensors. The transfer of thermal energy to liquid helium 2 was measured from low heat flow densities to a peak flux value, covering the regions of solid-liquid Kapitza conductances and film boiling conductances. Aside from D.C. measurements, frequencies from 1 to 10 Herz were used in the experiments with pulse durations from 2 to 10 milliseconds. An additional D.C. run conducted with a 13 mil diameter carbon filament showed that the thermal conductances in film boiling and the peak fluxes at the onset of vaporization depended distinctly on the depth of immersion of the apparatus in He 2. Dissert. Abstr.

N70-20251 Lehigh Univ., Bethlehem, Pa.
A STUDY OF THE DYNAMIC CHARACTERISTICS OF HELICAL WOUND HEAT EXCHANGERS
Charles Joseph Messa (Ph.D. Thesis) 1968 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-7350

Six Helical Wound Heat Exchangers have been studied in order to determine the dynamic response of the shell side exit temperature to disturbances in the shell side inlet temperature. Frequency response characteristics were measured experimentally and predicted independently from mathematical models. Pulse tracer techniques were used to measure the overall shell side flow pattern. A two parameter flow model was developed from these studies. A mathematical model was formulated to predict the shell side dynamic squeeze under conditions of heat transfer. The heat transfer model described shell side flow using the flow pattern model and assumed a plug flow regime in the tube side. The shell side frequency response characteristics were measured experimentally for a range of shell side flow rates using pulse testing techniques. These measured characteristics were compared to those predicted by the mathematical model. Satisfactory prediction of the range and the mode of the frequency response characteristics was obtained. Dissert. Abstr.

N70-20401*# Mechanical Technology, Inc., Latham, N.Y.
A REVIEW OF CRITERIA FOR PREDICTING INCIPIENT NUCLEATION IN LIQUID METALS AND ORDINARY FLUIDS
J. H. Vohr and T. Chiang Nov. 1969 78 p refs
(Contract NASw-1705)
(NASA-CR-108896; MTI-69TR45) Avail: CFSTI CSCL 20M

A state-of-the-art review with regard to the understanding and prediction of incipient nucleation is presented, emphasizing alkali metals. A critical summary of the status of experimental work on alkali metal boiling inception superheat problem is given. Parameters affecting the incipient boiling superheats are identified as boiling pressure, surface finish, dissolved gas content, heat flux, preboiling deactivation, and flow rate. Analytical models for predicting a level of superheat required for incipient boiling are discussed, and a photomicrograph study of surface cavities is included. N.E.N.

N70-20416*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
AN INVESTIGATION OF NEAR CRITICAL AND SUPERCRITICAL BURNING OF FUEL DROPLETS Annual Report, 1 Sep. 1968-31 Dec. 1969
G. M. Faeth 30 Jan. 1970 17 p refs
(Grant NGR-39-009-077)
(NASA-CR-108904; AR-3) Avail: CFSTI CSCL 21B

Experimental droplet burning rates were obtained at atmospheric pressure in a combustion gas environment. Burning rates were measured for n-paraffins and alcohols at gas temperatures in the range 1650-2550 K and oxygen concentrations in the range 0-40%. The use of the diffusion flame theories of droplet combustion, both constant and variable property, gave burning rate predictions within 40% of the measurements over the test range. However, the theories showed a systematic failure with increasing fuel molecular weight. Theoretical and experimental work was also done at high pressures to investigate droplet combustion in the critical region. Allowance for real gas effects and ambient gas solubility in the liquid phase had a substantial effect in determining the pressures required for a supercritical combustion. The value of the Lewis number also exerts a strong influence on the pressure requirements for supercritical combustion, with the pressure increasing for lower Lewis numbers. Author

N70-20440*# Bureau of Mines, Pittsburgh, Pa.
PHYSICAL AND EXPLOSION CHARACTERISTICS OF HYDRAZINE NITRATE
Harry K. James, Yael Miron, and Henry E. Perlee Mar. 1970 27 p refs
(NASA Order T-39882(G))
(NASA-CR-108935; BM-IC-8452) Avail: CFSTI CSCL 19/1

Experimental studies of the physical and explosion characteristics of pure hydrazine nitrate and multicomponent systems containing hydrazine nitrate, supplemented with an extensive literature survey, are presented. Such properties as melting point, heat of fusion, density, viscosity, surface tension, thermal stability, decomposition process, detonation velocity, impact sensitivity, and TNT equivalence are included. Author

N70-20442*# Illinois Univ., Urbana. Heat Transfer Lab.
FINITE DIFFERENCE SOLUTIONS OF THE BOUNDARY LAYER EQUATIONS
A. M. Clausing Feb. 1970 119 p refs
(Grant NGR-14-005-138)
(NASA-CR-108909; ME-TR-138-1) Avail: CFSTI CSCL 20D

The feasibility of employing film cooling as an alternate thermal protection system for spacecraft during atmospheric reentry was investigated by a systematic analysis of the application of finite difference techniques to the boundary layer equation. The objectives of the analysis were: (1) to clarify the physical characteristics of similar flows, (2) to show the advantages of the recognition of

similarity in finite difference solutions in the physical plane, and (3) to provide detailed comparisons for deciding whether similarity transformations result in a mathematical simplification if numerical techniques are employed. Tables of numerical results, and graphs of numerical comparisons are included. F.O.S.

N70-20491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL RADIATIVE PROPERTY MEASUREMENTS USING CYCLIC RADIATION
John R. Jack and Ernie W. Spisz Washington Mar. 1970 35 p refs
(NASA-TN-D-5651) Avail: CFSTI CSCL 20M

An experimental technique that determines simultaneously the total hemispherical emittance, solar absorptance, and the absorptance-emittance ratio for various materials over a substantial temperature range is discussed. The method is based upon comparing the temperature response of a thin, flat, isothermal sample to a sinusoidal perturbation of an imposed incident radiation. An experimental validation of the method is presented along with experimental thermal radiative property data for a variety of materials at temperatures ranging from 150 to 600 K. Twelve metals, a Z-93 coating, a black velvet paint, and a composite material (a CdS solar cell) were investigated to demonstrate the capabilities and the general utility and versatility of the cyclic radiation method for determining thermal radiative properties. Author

N70-20492 National Lending Library for Science and Technology, Boston Spa (England).
RATE OF COMBUSTION AS A FUNCTION OF PRESSURE AND TEMPERATURE
Karoly Remenyi 17 Dec. 1969 7 p refs Transl. into ENGLISH from Magyar Kemikusok Lapaja (Hungary), v. 9, 1968 p 499-501
(NLL-CE-Trans-5271-(9022.09) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The pressure and temperature effects on the combustion rate are dealt with, considering the conditions existing in turbulent flames. A critical temperature was determined for reactions proceeding at constant pressure by studying the change of the reaction rate with temperature, on the basis of the fundamental equations of reaction kinetics. The order of reaction influences the value of the critical temperature. Author

N70-20535*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ZERO-GRAVITY FLAMMABILITY
John Howard Kimzey *In its* Space Process. and Manufacturing 5 Feb. 1970 p 323-333 refs (See N70-20517 08-30)
Avail: CFSTI CSCL 20M

A study of flammability in a zero-g environment, based on results obtained during aircraft flight, is discussed. The need for long-duration zero-g testing to study inflight spacecraft fire propagation, safe spacecraft designs, and methods of fire extinguishment is shown. The objectives of Apollo Applications Program Experiment M-479 (which concerns flammability in zero g and the equipment needed for the experiment) are discussed. Author

N70-20622# Stanford Research Inst., Menlo Park, Calif.
EFFECT OF MASS OSCILLATIONS ON THE IGNITABILITY OF A HETEROGENEOUS SYSTEM Interim Report
C. M. Ablow and H. Wise 15 Nov. 1969 17 p refs
(Contract Nonr-3415(00))
(AD-698151) Avail: CFSTI CSCL 21/2

For a heterogeneous system with heat generation by solid-gas reaction and heat loss by conduction-convection, the mass oscillations at the interface can play an important role in ignition. A theoretical analysis was carried out for such a system in which the ignition process was defined in terms of a reaction mechanism involving transition from kinetic to diffusive control. In a numerical example it was shown how the ignitability of a system varies with initial temperature, oscillation frequency, and amplitude. The analysis offers some indication of the importance of various parameters on the ignition and extinction of an oscillating heterogeneous system. Author (TAB)

N70-20638*# Fundamental Methods Associates, Inc., New York.
THERMAL AND ELECTROMAGNETIC RADIATION FROM DUST STRUCTURES
Sylven N. Cutler and Carl N. Klahr Washington NASA Mar. 1970 83 p refs
(Contract NASw-1374)
(NASA-CR-1530) Avail: CFSTI CSCL 20M

An experimental program was conducted to determine behavior of dust particles as possible structured arrays for thermal and electromagnetic radiators in the space environment. The materials employed have been in the forms of dust particles with masses of 10 to the minus 8 power gram, and long ultra-thin flattened strips. The important characteristic of these materials is their large surface area-to-mass ratio. X-band radiation interacting with random metallic dust volume distributions and long thin metallic strip arrays was also measured. The experimental results are compared with the theoretical prediction and the two are found to agree. Author

N70-20706# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
THE TEMPERATURE DEPENDENCE OF THE THERMAL CONTACT RESISTANCE ACROSS NONMETALLIC INTERFACES Technical Report, 1 Jun. 1968-1 Oct. 1968
Merrill L. Minges Oct. 1969 167 p refs
(AD-697988; AFML-TR-69-1) Avail: CFSTI CSCL 20/13

Extensive measurements of thermal contact resistance were conducted in the following study areas, where no previous systematic measurements have been performed: (1) interfaces consisting of brittle, nonmetallic components, and (2) radiative transport across the interface at high temperatures. An apparatus for performing the measurements to elevated temperatures was designed, constructed, and performance tested. The equipment, operated in vacuum environments, utilized tantalum heaters to develop heat flow down a specimen column which was water cooled at its base. The contact resistance specimen column consisted of two high purity beryllium oxide cylinders, 1 inch in diameter and 1.5 inches in length. The successful performance of the apparatus was demonstrated by measuring the thermal conductivity of beryllium oxide and tantalum as a function of temperature. Analytical predictions of heat losses from the specimen column were made through solution of the boundary-value problem for the temperature field in the insulation segment surrounding this column. The results compared favorably with experimental heat loss measurements. Author (TAB)

N70-20716*# TRW Systems Group, Redondo Beach, Calif.
DESIGN STUDY TO IMPROVE PIONEER LOUVER SYSTEM THERMAL PERFORMANCE Final Report, 1 Jun. 1967-1 Feb. 1968
O. W. Clausen Feb. 1968 70 p refs
(Contract NAS2-4266)
(NASA-CR-73179; TRW-08619-6001-R000; EM-18-1)
Avail: CFSTI

The results are described of a design study directed towards improving the thermal performance of the present Pioneer 4 thermally actuated louver system. An experimental program was conducted to quantitatively assess the heat losses of the present unit in a closed condition. Based on the results of these tests and on analytical studies of the characteristics of an open system, an improved configuration was designed, fabricated, and thermally tested. The improved design had an effective emittance of 0.82 in the open position (compared to 0.73 for Pioneer) and 0.07 in the

closed condition (0.20 for Pioneer). These results show a 220% increase in the dynamic range (open to closed emittance ratio). Preliminary structural and dynamic analyses performed on the improved system indicated the unit could withstand the vibration environment associated with a typical Pioneer launch. Author

N70-20744*# Lockheed Missiles and Space Co., Palo Alto, Calif.
THIN RADIATING SHOCK LAYER ABOUT A BLUNT BODY
Y. S. Chou and L. H. Blake. Washington: NASA, Mar. 1970. 91 p refs
(Contract NAS7-632)
(NASA-CR-1547) Avail: CFSTI CSCL 20D

A theoretical study is performed of the flow in a thin shock layer about axisymmetric blunt bodies by a Blasius type series expansion technique. Solutions were obtained for three terms in the series, and the validity of the resulting solutions is shown to converge numerically away from the stagnation point to a body angle near the sonic line. The coupling experienced between the radiative and viscous transport was determined. Solutions are obtained for both the viscous and inviscid models at three extreme earth reentry flight conditions. A real gas model which is both emitting and absorbing radiant energy in a three-band continuum radiation model is considered. The differential approximation method is used to describe the radiative transport. A cold, non-blowing wall is assumed and the Prandtl number as well as the viscosity-density ratio are assumed constant. The results indicate a weak coupling between viscosity and the radiative flux distribution. The influence of radiative transport upon the convective heating is shown to be significant; however, the effect of radiative transport upon the velocity field is small. Author

N70-20898# Rensselaer Polytechnic Inst., Troy, N.Y.
STUDIES OF GAS-PARTICLE HEAT TRANSFER COEFFICIENTS IN PACKED AND FLUIDIZED BEDS BY FREQUENCY RESPONSE TECHNIQUES. Annual Progress Report, 1 Jan. - 31 Dec. 1969
Howard Littman. Sep. 1969. 7 p refs
(Contract AT(30-1)-3639)
(RPI-3639-9) Avail: CFSTI

Experimental data are given for the gas-particle heat transfer coefficient at Reynolds numbers between 2 and 100 using a model which takes into account axial dispersion of heat in the gas phase and axial conduction in the solid phase. Beds of copper, glass, and lead were used with particle sizes ranging from 0.0198 to 0.080 in. dia. Dynamic thermal conductivities of the solid phase in the direction of flow were measured simultaneously. Other experiments performed have extended the Reynolds number range down to 0.3. Work is proceeding on the extension of the conduction-dispersion model to account for radial gradients in packed beds. NSA

N70-20926# Army Materials and Mechanics Research Center, Watertown, Mass. Metals Lab.
THERMAL RADIATION SHIELDING FOR HIGH TEMPERATURES
S. William Gouse, Jr., Joseph J. Prifti, and James Brown. Aug. 1969. 32 p refs
(AD-697730; AMMRC-TR-69-20) Avail: CFSTI CSCL 20/13

A limited analytical study of thermal radiation shielding for high temperature applications was conducted. Two problems were considered: zero thickness-infinite parallel planes in vacuum, and finite thickness-infinite parallel planes in a monatomic gas atmosphere. Limited results are depicted graphically for several cases. In addition, the results include criteria for determining the proper shield spacing to suppress natural convection of the gas between the shields. The major conclusion is that the total normal emissivity of the shields is the controlling parameter. The thermal conductivity of the shield and of the gas is not significant for the range of variables studied. Author (TAB)

N70-20928# California Univ., Berkeley.
ON THERMODYNAMICS, RATE OF WORK AND ENERGY
P. M. Naghdi and A. E. Green. 1969. 27 p refs. Prepared in cooperation with Oxford Univ.
(Contract N00014-69-A-0200-1008)
(AD-697696) Avail: CFSTI CSCL 20/13

After some preliminary remarks concerning the thermodynamical theory of single phase continua, the balance of energy concept is examined and the mathematical statement of this principle is written in its most primitive form. The consequences of the generalization achieved in special cases are studied; application to materials with memory is considered. Author (TAB)

N70-20979# Ohio State Univ., Columbus. Aeronautical and Astronautical Research Lab.
RESEARCH ON PROBLEMS OF HIGH ENTHALPY FLOWS. Final Report, 1 Oct. 1964-31 May 1969
Robert M. Nerem. Wright-Patterson AFB, Ohio: ARL, Sep. 1969. 61 p refs
(Contract SF33615-68-C-1249; AF-33(615)-2220)
(AD-697397; ARL-69-0145) Avail: CFSTI CSCL 22/2

A series of studies on the physics of reentry were carried out at conditions simulating flight velocities ranging in excess of 50,000 feet per second. These efforts have largely centered on (1) radiative transfer effects in high temperature flows and (2) convective heat transfer in high enthalpy boundary layers. Both experimental and theoretical investigations have been carried out and a summary of this research is presented along with a complete listing of all publications and papers generated by this research. Author (TAB)

N70-21001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT AND MASS TRANSFER IN NON-NEWTONIAN FLUIDS: COLLECTION OF ARTICLES
B. M. Berkovskii et al. 3 Apr. 1969. 386 p refs. Transl. into ENGLISH from the Russian
(AD-697615; FTD-MT-24-306-68) Avail: CFSTI CSCL 20/4

Reports presented at the symposium can be divided into several groups: Theoretical and experimental investigations of hydrodynamics and convective heat and mass transfer of purely viscous non-Newtonian liquids (exponential or structurally-viscous) during laminar flow in channels and boundary layer; Theoretical and experimental investigations of flow stability of purely viscous non-Newtonian liquids in channels; Methods and equipment for measurement of thermophysical, rheodynamic, and structural characteristics of rheological systems; Applied questions pertaining to investigations of different concrete systems, varnish and paint, structural materials, massecuites, furan resins, and others. Author (TAB)

N70-21014# Los Alamos Scientific Lab., N.Mex.
CALCULATION OF HEAT TRANSFER TO GASES FLOWING IN A CIRCULAR TUBE WITH ARBITRARY WALL HEAT FLUX DISTRIBUTIONS
C. A. Bankston and D. M. Mc Eligot. 17 Apr. 1969. 15 p refs
(Contract W-7405-eng-36)
(LA-4154) Avail: CFSTI

Calculation of Nusselt numbers and wall temperatures for turbulent and laminar pipe flows with varying thermal boundary conditions by the method of superposition was investigated. Superposition of eigenvalue solutions and empirical correlations were employed, and both constant-property and variable-property fluids are considered. It was shown that accurate results can be obtained by this method provided that the superposition is properly formulated and, in the case of property variations, that the transverse temperature gradients are not too severe. Author (NSA)

PUBLIC COLLECTIONS OF NASA DOCUMENTS

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-19925*# Colorado State Univ., Fort Collins.
BIOLOGY AND ENGINEERING OF SPACE AND PLANETARY LIFE SYSTEMS Annual Report
Sep. 1969 52 p refs
(Grant NGL-06-002-038)
(NASA-CR-108218) Avail: CFSTI CSCL 06D

CONTENTS:

1. STIMULATION OF CARDIOVASCULAR ADAPTABILITY DURING PROLONGED SPACE EXPOSURE H. A. Gorman 8 p (See N70-19926 08-04)

2. EXPERIMENTAL INVESTIGATIONS INTO THE PERFORMANCE OF A 20 cm HOLLOW CATHODE THRUSTER G. Palumbo, P. Wilbur, and R. Vahrenkamp 20 p refs (See N70-19927 08-28)

3. EXTINCTION OF INFRARED RADIATION DUE TO ATMOSPHERIC HAZE Y. Pann and W. Marlatt 15 p refs (See N70-19928 08-13)

N70-20159# Joint Publications Research Service, Washington, D.C.
ON FORECASTING SYSTEMS
V. A. Lisichkin 2 Feb. 1970 58 p Transl. into ENGLISH of the book "O Prognozirvyushchikh Sistemakh" Moscow, 1969 p 1-60
(JPRS-49730) Avail: CFSTI

Scientific-technical and social-economic forecasting systems are considered as instruments for the development of optimal strategy in the growth of science and technology in the face of increasing complexity of interrelationships of all branches of the national economy. Forecasting is assessed a rational tool for reduction of unplanned, game situations accompanying the process of scientific research and economic activity. The transition from individual predictions to complex forecasts of complicated objects includes the classical methods of linear forecasting, and finite mathematics. The effectiveness of scientific forecasting appears most fully in the development of systems for continuous forecasting. E.M.C.

N70-20340# Texas Univ., Austin. Electronics Research Center.
BASIC RESEARCH IN ELECTRONICS: BIANNUAL OF ELECTRONICS RESEARCH Final Report
D. G. Swanson, Edward J. Powers, Francis X. Bostick, Philip C. Richardson, and Terry J. Wagner 15 May 1969 233 p refs
(Grant AF-AFOSR-67-0766E)
(AD-694565; AFOSR-69-1321TR) Avail: CFSTI CSCL 9/3

Research topics in progress, recent findings, and future plans in the areas of biomedical electronics; information sciences; physical, quantum, and plasma electronics; and acoustics and radio sciences are presented. Author (TAB)

N70-20358# Iowa Univ., Iowa City. Mechanics and Hydraulics Dept.
THE EQUATIONS OF MOTION FOR A SPECIAL CLASS OF WEAPON VEHICLE SYSTEMS
James G. Andrews Jul. 1970 59 p
(Contract DAAF03-69-C-0014)
(AD-698014) Avail: CFSTI CSCL 19/3

In order to evaluate the preliminary design of any weapon-vehicle system and to predict the effectiveness and efficiency of its performance under a variety of environmental conditions, it is necessary to (1) construct a mathematical model of the system, (2) derive the equations which govern the motion of the components of this model during a typical fire mission, (3) obtain the solutions to these equations and the variations in these solutions due to changes in the system parameters, changes in the motion of the target relative to the vehicle, changes in the vehicle's environment and its motion in this environment, and changes in the characteristics of the input forcing functions used to properly align the weapon, and finally, (4) verify the theoretical predictions obtained for the system model by performing a series of experimental tests on a system prototype. This report is concerned with the first two portions of this overall scheme of design evaluation, namely (1) the construction of a model for a certain class of weapon-vehicle systems, and (2) the derivation of the equations governing the motion of the components of the model during a typical fire mission. Author (TAB)

N70-20550*# National Aeronautics and Space Administration, Washington, D.C.
BACKGROUND MATERIAL AND NASA FY 1971 BUDGET BRIEFING: NEWS RELEASE
2 Feb. 1970 60 p
Avail: NASA Scientific and Technical Information Division

The details of a new space program for the 1970s are discussed and contrasted with the space program of the 1960s. The FY 1971 budget is presented, and its implications are explained. M.G.J.

N70-20568*# New York Univ., N.Y.
CONTINUING ENGINEERING EDUCATION: WHO REALLY NEEDS IT ? WHAT IS THE MARKET FOR CONTINUING EDUCATION ?
Fred Landis Nov. 1969 40 p Presented at the Continuing Eng. Studies Div., Am. Soc. for Eng. Educ., 4th Ann. Conf., Pittsburgh, 6 Nov. 1969
(Grant NGL-33-016-067)
(NASA-CR-108942; C-69-2) Avail: CFSTI CSCL 05I

A market research study of continuing education for engineers is presented with emphasis on the nondegree programs. It is shown that about four to eight years after graduation the engineer becomes concerned with developing within his company rather than within the profession, and his interests in climbing the managerial ladder result in greater time demands than intellectual. Tabulated results of questionaires completed by Engineers in industry are included. Conclusions are: (1) Most engineers are not interested in continuing education; they are interested in learning how to improve the skills required for their current job. (2) The contribution of most engineers to their company may have little to do with their expertise in engineering, and real technical competence is rarely demanded. (3) Even though corporate management may express a real interest in continuing education, it is the immediate supervisor that counts. F.O.S.

N70-20818# RAND Corp., Santa Monica, Calif.
SUPPLY RESPONSE IN THE COLOMBIAN COFFEE SECTOR
Merrill J. Bateman Oct. 1969 59 p refs
(Contract F44620-67-C-0050)
(AD-697390; RM-5760-RC/AID) Avail: CFSTI CSCL 5/3

The coffee industry in Colombia has a continuing production surplus that is of great policy concern to the government. This memorandum formulates an econometric model of the supply of Colombian coffee to use in estimating how the coffee industry would respond to price incentives to lower production. Empirical results obtained from the model suggest that (1) changes in price do not affect the intensity of harvesting, (2) there are lags of 5 years between price changes and 7 years between production changes, and (3) the elasticity of coffee supply with respect to price is about 0.5. These findings imply that a 20 percent reduction in producer prices would lead to a 10 percent reduction in coffee production, but only after 7 years. Author (TAB)

N70-20856*# New Hampshire Univ., Durham. Dept. of Electrical Engineering.
ELECTRICAL NETWORK ANALYSIS OF SOCIO-ECONOMIC SYSTEMS UTILIZING GRAPH THEORY
Darrel D. Lynch (M.S. Thesis) Feb. 1970 45 p refs
(Grant NGR-30-002-056)
(NASA-CR-109088) Avail: CFSTI CSCL 05H

A model of the New Hampshire highway system is proposed, and investigated to determine if it will provide useful information. It consists of a graph with nodes representing population centers, and links representing connecting highways. This model is easily analyzed by the IBM ECAP computer program, and was used to determine the vehicular traffic flow between communities. The desired electrical analogs are defined. Tabulated results of the ECAP analysis of the model are discussed, and the complete ECAP program is included. The principal problem area is considered to be a conflict between net current flow and total traffic flow. F.O.S.

N70-20857# National Science Foundation, Washington, D.C.
FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND OTHER SCIENTIFIC ACTIVITIES, FISCAL YEARS 1968 - 1970, VOLUME 18
Aug. 1969 288 p
(NSF-69-31) Avail: Issuing Activity

The funding allotments for basic and applied research, science and engineering activities, information obligations, agencies, and R&D plants are described. Levels and trends, and geographic distribution are given, and technical notes and statistical tables are included. N.E.N.

N70-20909# Stanford Univ., Calif. Electronics Labs.
[RESEARCH OF THE STANFORD UNIVERSITY ELECTRONICS LABORATORIES] Quarterly Status Report, 1 Jul.-31 Sep. 1969
1969 102 p refs
(Contract NONR-225(83))
(AD-697651; SU-SEL-69-052; QSR-115) Avail: CFSTI CSCL 20/9

Contents: Plasma physics and quantum electronics; Radioscience; Solid-state electronics; Systems theory; Digital systems. TAB

N70-20920# Advisory Group for Aerospace Research and Development, Paris (France).
GLOSSARY OF DOCUMENTATION TERMS
H. A. Stolk [1969] 41 p refs
Avail: CFSTI

Frequently used documentation terms are defined and presented in alphabetical order. M.H.E.

N70-21049# North Carolina Univ., Chapel Hill. Materials Research Center.
RESEARCH ACTIVITIES IN THE FIELD OF MATERIALS SCIENCE Annual Technical Progress Report, 1 Jul. 1968-31 May 1969
31 May 1969 98 p refs
(AD-696131; SD-100) Avail: CFSTI CSCL 5/2

Summaries of research activities: Transport studies on solid ionic materials using ohmic contacts; Spark source mass spectrometer of low volatility organic and biologically significant materials; Structures of C4 radical cations; Ion-molecule reactions; Solubilization of a neutral phenazyl free radical by DNA; EPR of transition metal ions in crystals; Spin-spin coupling in magnetically condensed complexes; Elastic properties of composites; Conformational stability of synthetic peptides; Triplet energy migration in pure fields; Spin-lattice relaxation in nematogenic compounds; Rates of motion for nitroxide radicals; Electron transfer reactions of metal complexes; Deuterium labeling in electrode process studies; Quantum theory of polyatomic molecules; Electrochemiluminescence reactions and photoelectrochemistry; Elucidation of elementary processes in electrodeposition reactions of metal complexes; 51V NMR study of vanadate(V) ions; NMR studies of porous polymers with fixed charged sites; The motion of a sphere in a perfect fluid, with application to liquid helium; Effect of water on the critical phenomena in the cyclohexane system; A study of electron delocalization in organophosphorus heterocycles; Exicted state participation in the radiation chemistry of nitrogen compounds and hydrocarbons; Polymerization of acrylic monosols and gels; Properties of prosthetic polymers; Trends of magmatic differentiation in plutonic rocks of the southeastern piedmont; Microwave transmission through thin superconducting Pb films; Phonon properties of highly disordered lattices by superconducting tunneling; Exciton states in linear molecular states; Studies of dipolar complexes in MgO. TAB

N70-21072*# Miami Univ., Fla.
FEDERAL SUPPORT AND STIMULATION OF INTERDISCIPLINARY RESEARCH IN UNIVERSITIES
D. E. Cunningham Oct. 1969 87 p
(Grant NGR-36-022-001)
(NASA-CR-108940; Rept-69-142) Avail: CFSTI CSCL 05B

The results of an attempt to determine what actions the various agencies of the Federal Government were taking in stimulating and supporting interdisciplinary research are described. The data were accumulated by visits to many federal agencies, and talks with many administrators of interdisciplinary research. This report attempts several things: (1) It looks to the need for conducting interdisciplinary research in our present day society. It examines what interdisciplinary research is, how it is conducted, and who is sponsoring it. (2) It looks to the methods so far used by Federal agencies to support research, not necessarily confining itself to the subject of interdisciplinary research. (3) It examines the drawbacks, limitations, etc., of the various forms of support so far used. It then considers how these various techniques of support could be directly applied to the support of multidisciplinary research. (4) It looks at the general limitations of conducting any type of interdisciplinary research program in the university, as the university now is structured. (5) It lists in tabular form the varied agencies of the Federal Government that are supporting interdisciplinary research, the means through which they are supporting it, the dollar amounts committed per year, and describes the general nature of each of the programs. (6) It reaches some conclusions concerning which techniques might be most appropriate for conducting and stimulating interdisciplinary research in the short run. Author

N70-21085# Naval Ordnance Lab., White Oak, Md.
LONGITUDINAL FORCES REQUIRED WITH LOOSE LINER BARREL CONSTRUCTION
Jack E. Goeller and Victor C. D. Dawson 15 Jul. 1969 14 p
(AD-697930; NOLTR-69-139) Avail: CFSTI CSCL 19/6

A previous study demonstrated the advantages that could be obtained in using loose liner naval gun barrel construction, particularly if the liner is autofrettaged. This report deals with the longitudinal forces required to assemble and disassemble such constructions and shows that with close control of tube straightness and initial clearance, these forces are relatively small. Author (TAB)

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